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Editor, James T. Case, M.D., Battle Creek, Mich.

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MEDICAL RESERVE CORPS

FROM: THE SURGEON GENERAL

TO: EDITOR, AMERICAN JOURNAL OF ROENTGENOLOGY,

BATTLE CREEK, MICHIGAN

1. I wish to call to the attention of the profession at large the urgent need of additional medical officers. As the war progresses the need for additional officers becomes each day more and more apparent. Although the medical profession of the country has responded as has no other profession, future response must be greater and greater. The Department has almost reached the limit of medical officers available for assignment.

2. I am, therefore, appealing to you to bring to the attention of the profession at large the necessity for additional volunteers. So far the United States has been involved only in the preparatory phase of this war. We are now about to enter upon the active, or the fighting phase, a phase which will make enormous demands upon the resources of the country. The conservation of these resources, especially that of man-power, depends entirely upon an adequate medical service. The morning papers publish a statement that by the end of the year a million and a half of men will be in France. Fifteen thousand medical officers will be required for that army alone. There are to-day on active duty 15,174 officers of the Medical Reserve Corps.

3. Within the next two or three months the second draft will be made, to be followed by other drafts, each of which will require its proportionate number of medical officers. There are at this time on the available list of the Reserve Corps, an insufficient number of officers to meet the demands of this draft.

4. I cannot emphasize too strongly the supreme demand for medical officers. Will you give the Department your assistance in obtaining these officers? It is not now a question of a few hundred medical men volunteering for service, but it is a question of the mobilization of the profession. In the large centers of population and at other convenient points as well as at all Army camps and cantonments, boards of officers have been convened for the purpose of examining candidates for commission in the Medical Reserve Corps of the Army. An applicant for the Reserve should apply to the board nearest his home.

5. The requirements for commission in the Medical Reserve Corps are that the applicant be a male citizen of the United States; a graduate of a reputable school of medicine, authorized to confer the degree of M.D.; between the ages of 22 and 55 years of age; and professionally, morally and physically qualified for service.

6. With deep appreciation of any service you may be able to render the Department, I am (Signed) W. C. GORGAS,

Surgeon General, U. S. Army

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BSERVATIONS ON ROENTGENOSCOPY AT THE FRONT *

BY R. DESPLATS, M.D.

Major, Of the French Army Ambulance Chirurgical Automobile No. 16

THESE few pages are only a summary of our personal experience in roentgenoscopy of the wounded at the front. Their purpose is to render service to our American colleagues, by giving them the benefit of the experience gained during three years of war. We must not, therefore, expect to find in them aught but a clear, simple and brief outline.

The information furnished the surgeon by the medical roentgenologist is of such importance as to decide the indication for an operation—more or less extended, according to the size of the projectiles, their anatomical position, depth, and trajectory in the tissues; and in accordance with the bony or other lesions observed in the course of the examination. These findings justify the numerous methods of localization, of operative guidance, and of extraction, described since 1914, and encourage greater rapidity, more absolute precision, more certain extraction; such, indeed, are the desires of the surgeons at the front, whom we must satisfy, and with whom we must work as sympathetically as possible.

The experience of 18 months' practice in mobile hospitals and the criticism which we have heard from surgeons and roentgenologists themselves, have taught us that the roentgenographical methods, the compasses, and extractions under screen should be used at the front only in exceptional cases, and that a careful screen examination with an exact notation of the number and volume of the projectiles, the depth and, as far as possible, the anatomical position of those which must be found and extracted, should suffice in most cases.

There is no doubt that this method of procedure is more rapid, once we have familiarized ourselves with fluorescent screen shadows and with certain common technical procedures. In order to have an exact understanding with the surgeon, there are certain principles which must be applied, without which the screen examination is incomplete, insufficient, and often misleading.

We would like here to review these directing principles, and discuss briefly the simple, rapid and precise technique which has always been sufficient for us.

I. General Instructions for Recognizing Projectiles.—The record of the screen examination which accompanies the patient to the operating room should indicate numerically all the projectiles imbedded in the tissues and describe them briefly, according to their volume (metallic dust, bean-size, pea-size, etc.); somewhat according to their form (round, cubical, elongated, sharp-edged splinter); always according to their position (external posterior aspect of the leg, dorsal aspect of the third metatarsal near its middle, etc.).

It is the result, more or less approximate, of a first examination that the roentgenologist registers in his record. Without this record, the surgeon might be led to believe there was an omission, if he observes that no projectiles have been recorded for a certain part of the body containing one or more wounds. It is enough to say that a negative examination of a member (free from projectiles, but not free from wounds) should be specially noted on the examination card. Such is the case with the so-called "seton" wounds, which often correspond to the wounds of entry of two projectiles still remaining in the tissues.

II. Recognition of Anatomical Lesions.—The patient's card should not only record the foreign bodies but also the fractures observed, with their situation, the direction of the fracture line, the visible fragments of bone, the apparent displacements, the bloody effusions (more or less abun-

* Translation from advance sheets of a forthcoming work by Desplats and Wickham.

dant when coming from the pleura), the immobility or mobility of the diaphragm, and when the projectile is located in the thorax or abdomen, its coincidence of movement with the diaphragm or the heartbeat. This information is of great value to the surgeon from the point of view of anatomical localization.

Insufficient in most cases, and often neglected, these details are none the less necessary. We have seen large dissections made to find a small projectile, because its size was not indicated. We have seen two enormous projectiles left in a member where they caused suppuration, because on the strength of a hasty and insufficient diagnosis of a "seton wound" made at the dressing station, a further examination of the member had not been made. We have seen projectiles in the knee not indicated on the patient's card, probably because they were considered too small. These are faults imputable to the roentgenologist. Although no one is exempt from such faults, this fact does not lessen their importance from the point of view of the patients' welfare, and the too frequent repetition of apparent errors practically takes away the surgeons' confidence in the value of the roentgen ray examination.

III. Examination for Superficial Projectiles.—Armed with a metallic instrument which serves as a probe, the roentgenologist searches rapidly among the foreign bodies for superficial ones, which he localizes easily on one side or the other; and with a dermographic pencil, he indicates them on the skin by means of a cross and a corresponding number, also making on the record sheet a notation, such as "superficial projectile under cross No. X., such and such a region." It is quite evident that the signs should be marked on the skin rather than on the dressings. Many surgeons have remarked to us that many wounded arrive in the operating room, with their dressings untouched and with numerous crosses on their dressings.

IV. Cases in Which We Can Omit Localization.—There remain the projectiles, more or less deep and more or less numerous, sometimes so numerous that the roentgenologist would hesitate at localizing them all exactly. Facts concerning position and volume must be taken into consideration here. We can only dispense with an exact localization in cases in which a small foreign body is deeply imbedded in a thick

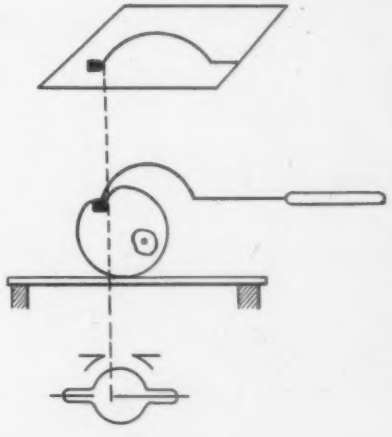

FIG. 1. MOBILIZATION OF A SUPERFICIAL PROJECTILE BY THE INDICATOR HELD IN THE HAND OF THE ROENTGENOLOGIST.

region outside the peritoneal cavity and far from neurovascular masses. In such cases we find it sufficient to indicate briefly on the patient's card "a projectile of the size of a lentil, in such and such a region," with the words "to be left in place."

In principle, all projectiles which are not too small or superficial should be exactly localized as to depth.

V. Methods to Be Employed Exceptionally or to Be Rejected.—We have seen many roentgenologists who insisted on using the two-axis method, which in France has come to be called the method of Debierne. According to them, this method is more acceptable to the surgeon. But it has the inconvenience of multiplying the marks on the skin, and sometimes involves an unnecessary amount of movement of the wounded man on the examining table. It seems to us that this method is not generally applicable, especially in cases of multiple wounds, or when the man is so

dangerously wounded that all unnecessary movements should be avoided.

This method, however, can be employed in certain cases (projectiles in the skull for example) when the two axes cross at right angles.

Many others, who only occasionally resort to the two-axis method, indicate the position of all their projectiles in relation to only one point marked on the skin, on the side closer to the projectiles, forgetting that it is impossible to orient one's self in the depth of the tissues with this insufficient information. This faulty method of procedure is so common that we have seen surgeons surprised to observe us

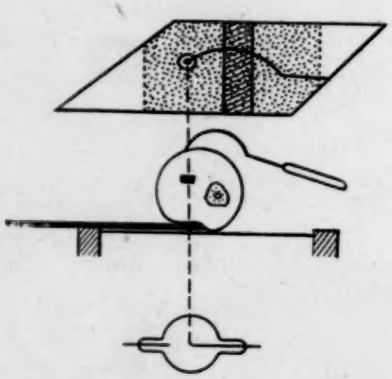

FIG. 2. DETERMINATION OF THE AXIS BY THE MEANS OF THE INDICATOR AND THE PERFORATED RULE.

mark two points, corresponding to the axis on which the projectile is found, assuring us that never had they seen this procedure before.

It is not surprising that under those conditions many surgeons take no notice of roentgenoscopic information and do without it so easily. They prefer to follow the direction of the wound, which guides them more surely to the projectile and in case of difficulty there is always the method of extraction under the screen to fall back on.

VI. The Importance of Indicating on the Skin the Axis of the Normal Incident Ray.—It is then necessary in principle to indicate always on the skin the point of incidence and the point of emergence of the normal incident ray (Fig. 2); in other words, the axis on which the estimation in depth has been made. The surgeon, always at liberty to look for the projectile in following the direction of the wound and during its *debridement* (cutting away soiled and bruised tissues), will continually have the opportunity of orientation in relation to this axis which he can reconstruct in space. Under these conditions (and only under these conditions) mistakes will be rare, and the roentgenologist can rest assured that these will not be charged to him.

The localization itself can be made by any method, provided it be a rapid and precise one.

VII. Localization in Reference to the Skin.—Amongst the elements of rapidity and precision, there is one which seems to us very little known. It is the marking of the skin by an opaque marker, placed tangentially to one edge of the shadow of the foreign body on the axis of the incident normal ray (on the side of the tube shift).

We usually employ a square piece of adhesive sheet lead (neotectine), or in cases where the precision is less exact, a metallic indicator in the form of a hook, whose end is flat and sufficiently opaque, which the operator must take care to hold immobile.

VIII. Exact Method of Localization in Depth.—Most of the screen methods of localization actually employed are based on the method of the double image of the projectile obtained simultaneously by a tube of double anticathode or successively by two positions of the anticathode; the calculations, the geometrical constructions, and the special apparatus permit one to infer from the separation of the shadows the distance from the projectile to the screen, and also the depth of the projectile in reference to a given point on the skin.

The method which we employ, communicated to the Academy of Sciences on the 6th of December, 1915, seems to us worthy of recommendation because of its simplicity. It is, in fact, a method of direct reading, thanks to the graphic here in-

cluded, which permits measurement of the depth of the projectile from the skin, in the same manner that one would measure with a graduated rule.

If we suppose that coinciding with OP (distance from the projectile to the screen)

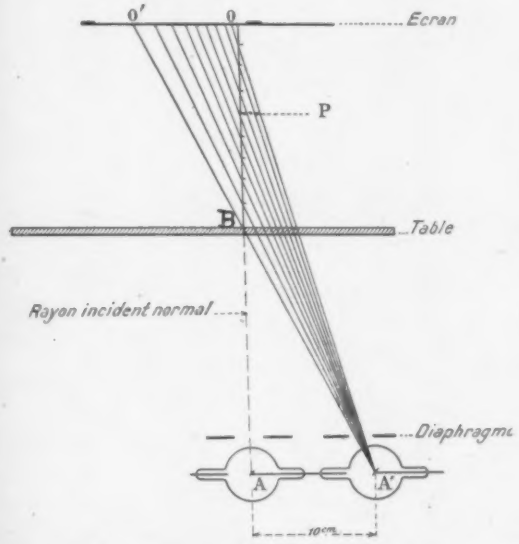

FIG. 3. PROJECTION ON THE SCREEN OF A GRADUATED RULER, PLACED ON THE INCIDENT NORMAL RAY BY A PENCIL OF RAYS, PRODUCED BY THE TUBE AFTER SHIFTING IT 10 CM.

we place a ruler OB, graduated in centimeters, and that we move the tube 10 cm. from A to A′, the ruler OB would be projected on the screen at OO′ and we could read directly at what point of graduation of OB the projectile can be found; this would constitute the direct reading of the distance OP (see Fig. 3).

In practice this arrangement can not be realized, but we can for each distance, AO (anticathode-screen), project, according to A′O′, the same graduated ruler, and we will thus obtain projections corresponding to an increasing value of AO from one centimeter to another.

To represent the different graduated rulers, corresponding to the different values of AO, we have marked on the ordinate line these values (arbitrary scale), and for each ordinate line in abscissa the values of OO′ in the proper size (see graphic appended to this article).

The formula demonstrates that all points corresponding to a given value of OP will be on the same hyperbole which we construct. This will give graphically the values of OO′ for the distances OA.

The steps of the procedure are as follows:

(1) The patient is placed on the examination table in such a position that the projectile will be closest to the screen.

(2) The incident normal ray passes tangential to one side of the projectile.

(3) We place on the skin a square piece of adhesive lead in such a position that the shadow of this indicator is tangent to the shadow of the foreign body.

(4) Move the tube 10 cm. to one side of the indicator (see Figs. 4 and 5).

(5) We draw on the glass of the screen two marks corresponding to the separation of the shadows, or practically with two pointers movable on a rule, parallel to one side of the screen (see Fig. 6).

(6) The tube is brought back to its original position. This permits us to verify if the patient has moved and if the indicator has remained in its original position.

(7) We introduce under the region examined, that is, under the side towards the tube, a flat, perforated ruler, having at one extremity an opaque ring (see Fig. 2) in such a manner that the shadow of the ring on the screen encircles the

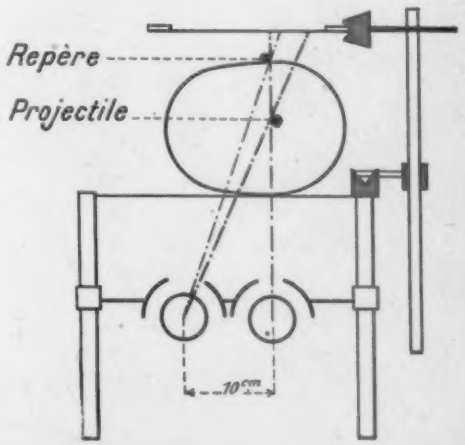

FIG. 4. LOCALIZATION OF A PROJECTILE BY THE ANTERIOR FACE. THE INDICATOR IS PLACED ON THE SIDE OF THE EXCURSION OF THE TUBE.

shadow of the projectile and the shadow of the indicator held in the observer's hand.

(8) Having turned on the light, we mark on the skin with an indelible pencil, or with ink, the axis of the incident normal ray (see Section VI).

(9) We measure the distance separating the screen from the operating table. Added to the known and fixed distance separating the anticathode from the table, we obtain the anticathode-screen distance.

Having traced on a piece of paper the two lines indicating the separation of the shadows, we place this paper on the graphic, by having one of the lines coincident with the line of the zeros, with the known anticathode-screen distance. The position of the second point gives the depth, in centimeters, of the projectile under the indicated point, by simply reading the number of intervals which separate the two points.

The explanation of this technique is more complicated than the technique itself. We have thought it advisable to discuss all the details, because each one is important. It is on their rigorous application that the accuracy of the results will depend.

IX. Localization of the Projectile in Depth in Reference to a Posterior Landmark.—It is very important when dealing with a seriously wounded patient, or one with multiple wounds, to avoid turning the patient over on the operating table under pretext of making the localization in reference to the point nearest the projectile.

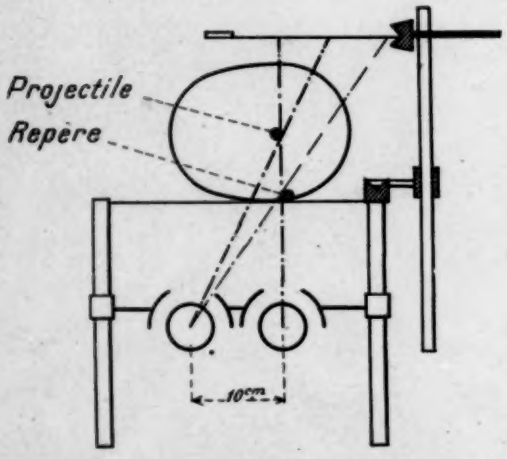

FIG. 5. LOCALIZATION OF A PROJECTILE BY A MARKER ON THE POSTERIOR ASPECT. THE INDICATOR IS PLACED ON THE OPPOSITE SIDE OF THE EXCURSION OF THE TUBE.

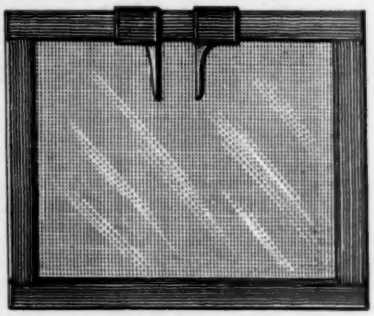

FIG. 6. SCREEN WITH TWO MOBILE INDICATORS, TO MEASURE THE DISTANCE BETWEEN THE SHADOW OF THE PROJECTILE AND THE SHADOW OF THE INDICATOR AFTER MOVING THE TUBE 10 CM.

As soon as the patient is brought into the examining ward, we endeavor to locate the point of penetration of the projectile and we lay him on his back or on his abdomen, according to the case. If we discover that one or more projectiles are closer to the side nearest the table, it is in reference to this side that we operate.

Without moving the patient we proceed in a method the reverse of the one ordinarily employed. We place the square of lead, or more simply we apply the metallic (hand-held) indicator, tangentially to the shadow of the projectile, to the part of the body nearest the table.

X. Practical Method of Localization in Reference to Posterior Direction.—In practice we must

(1) Place the metallic indicator on the skin on the side of the point of incidence (posterior face) in such a way that the shadow will be tangent to the shadow of the foreign body on the incident normal ray.

(2) Move the tube 10 cm. towards the side opposite to the tangent line of the shadows (see Fig. 5).

(3) Record by means of the metallic

slides or by two pencil lines, the distance between the two shadows.

(4) Measure with the caliper (Fig. 7) the length of the axis (point of incidence to point of emergence of the incident normal ray), adding to it if necessary the distance from the screen to the point of emergence.

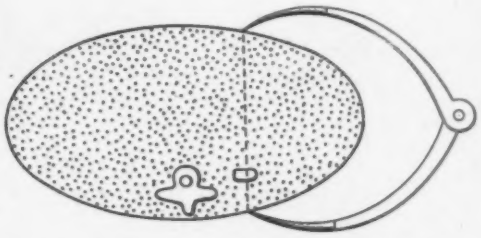

FIG. 7. UTILIZATION OF THE CALIPER IN CONNECTION WITH AUTHOR'S TECHNIQUE FOR THE LOCALIZATION OF THE PROJECTILES BY A MARKER OR INDICATOR HELD POSTERIORLY.

(5) It will then be easy to find the depth of the projectile on the centimeter ruler corresponding to the anticathode-screen distance.

XI. Depth Verification in Certain Delicate Cases.—It happens in some rather delicate cases that the roentgenologist is doubtful as to the value of the information he gives to the surgeon; to which method shall he have recourse to verify his diagnosis?

In such cases we usually turn the injured member at an angle of 90° and having made sure that the line joining the point of incidence to the point of emergence is parallel to the table, we pass the incident normal ray successively through the projectile and through the marker, thus indicating on the screen the exact depth of the projectile (see Figs. 8 and 9).

XII. Anatomical Localization and Orthodiagrams.—It will not be difficult in many cases to draw exact conclusions from the point of view of anatomical localization. We have said (see paragraph II) that other roentgen ray findings could be taken into consideration.

In other cases (intra-articular projectiles) it is in the best interest of the surgeon to have a document which will clearly indicate to him the relation of the projectile to the bones in the vicinity. This is of much more importance to him than a landmark on the skin.

The document which we furnish is an anteroposterior and a lateral orthodiagram

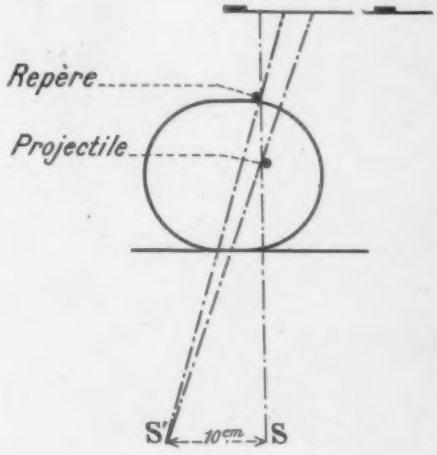

FIG. 8.

in preference to a simple screen tracing which gives distorted shadows and which may falsify the record. It is sufficient to trace with an indelible pencil on the glass of the screen the incidence of the rays coming out of a small diaphragm above the tube. This the assistant moves while the operator traces.

XIII. The Uses of Roentgenography, of the Hirtz Compass, and of Extraction Under

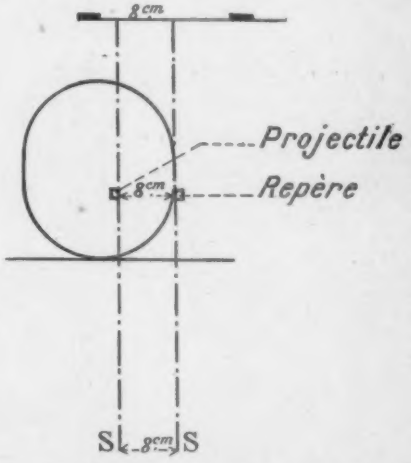

FIG. 9. VERIFICATION OF THE METHOD BY TURNING THE MEMBER 90°, AND MEASURING ON THE SCREEN THE DISTANCE BETWEEN THE SHADOW OF THE PROJECTILE AND THE SHADOW OF THE INDICATOR.

a Screen.—We shall only mention roentgenography as an exceptional method. There is no doubt that for the majority of French roentgenologists at the front

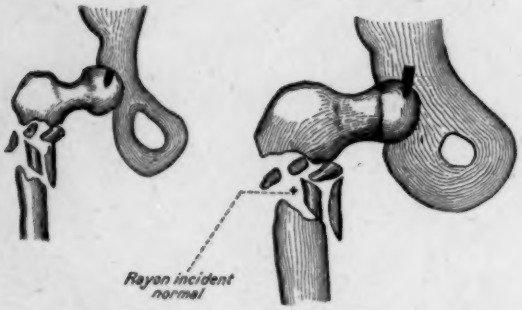

FIG. 10. FIG. 11.

FIG. 10. ORTHODIAGRAM SHOWING A COMPLICATED FRACTURE OF THE SUPERIOR OF THE FEMUR, AND A PROJECTILE APPARENTLY AT THE LEVEL OF THE FEMORAL HEAD.

FIG. 11. A PROJECTION OF THE SAME FRACTURE, SHOWING THE BONES ENLARGED AND DISFORMED. THE PROJECTILE IS AT A LEVEL ABOVE THE FEMORAL HEAD.

roentgenoscopy furnishes, from the point of view of the localization of the projectiles, information just as precise as roentgenography. Why then prefer a long, costly and complicated method, which can only be a method of complement, to a simple and rapid method which is sufficient in itself? Let it be well understood that roentgenography is properly indicated in the study of fractures, except perhaps those of the extremities.

We will speak only of the compass of Hirtz, and similar instruments, to point out that it is an instrument of guidance for the operator, based on data obtained by screen or plate localization. It has the inconvenience of being able to be used for only one projectile at a time.

As to extraction under the screen, it seems to us that we must have recourse to it more and more frequently at the front during quiet intervals, because we have a preference for primary suture of the surgical wounds; it therefore seems illogical, under those conditions, to leave in the muscular tissues even small projectiles which are hard to extract. We insist on the fact that extraction under the screen should always be preceded by an exact localization in the fluoroscopic room. This is the only method of giving to the surgeon exact information as to the depth of the projectile.

Shall we recommend operating in a darkened room under a fluorescent screen, or in the operating room with a bonnet fluoroscope for the roentgenologist only? The first method is certainly preferable from the point of view of good visibility for the roentgenologist himself; it also permits the surgeon to glance at the screen if necessary. The second has the advantage of being practicable in any operating room, but requires perfect adaptation of the eyes of the observer and a greater milliamperage through the tube (3 to 4 milliamperes). We should hold ourselves in readiness to employ one or the other of these methods, according to circumstances. To make a habit of either would be a practice both useless and dangerous.

LOCALIZATION OF FOREIGN BODIES

THE STANDARD METHODS APPROVED BY THE SURGEON GENERAL'S OFFICE, U. S. ARMY

BY J. S. SHEARER, U.S.N.A.

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EXPERIENCE in military service during the present war has served to emphasize the importance of rapid and reasonably accurate methods for the localization of foreign bodies. The ordinary practice of roentgenology, as a rule, has little to do with this phase of the subject. In civil practice methods could be used which required a considerable amount of time, and it was usually possible to consult with the surgeon and to repeat observations to an extent quite impossible in the present emergency. The localization of small projectiles in the eye had been developed in quite a satisfactory manner and no distinct improvement therein has been attempted. During the war abroad a variety of methods and appliances have been used and the choice of method has been left largely to the individual operator, since circumstances prevented systematic attention to either mechanical equipment or special training.

According to the reports received from several excellent surgeons in active service at the front, it would be desirable, and may even be regarded as necessary, that all of the injured should have the benefit of an *x*-ray examination; since it has been found that there are many cases where foreign bodies split off after entry, or are in such unexpected or peculiar positions that they can hardly be successfully handled without the evidence available from such an examination.

In order to work on such an extensive scale it is necessary to consider very carefully the relation of *x*-ray work to surgery, and to analyze the methods which are to be employed with reference to simplicity and certainty, and to pay particular attention to the reports and information needed by the surgeon in order to facilitate his work. In this connection it may be remarked that there is a distinction between the *x*-ray requirements in evacuation hospitals and base hospitals. In the former, speed is essential and simple apparatus must suffice. In the latter, a more complete equipment would be expected. It may be well to recognize that time will not permit the use of plates or films in the evacuation hospitals and dependence must be put almost entirely upon fluoroscopic work. Consequently, all arrangements in hospitals near the front must conform to the conditions imposed by fluoroscopy.

As regards the methods that have been selected, it is not claimed that they are original, and no effort has been made to get any universal or entirely new procedure. After consideration of many methods it has been deemed wise to limit selection to those that best meet certain requirements. Among the desirable features more or less well met by various methods we may mention:

1. The apparatus required should be simple.
2. The manipulation should not require an undue amount of skill.
3. The time required should be a minimum consistent with reasonable accuracy.
4. All operations likely to lead to error must be excluded.
5. The comfort of the patient should be considered.

It must also be remembered that the operator is an essential part of the localizing apparatus and it is perfectly evident that medical men have not generally been trained in geometry and algebra. It is therefore necessary to devise methods which will relieve the operator of computa-

tion and thus reduce the chances of error, especially when an enormous amount of work is to be done under trying conditions. Among the operations giving opportunity for error even in ordinarily competent hands we may note:

1. Reading of fine scales.
2. Reading any scale in bad light.
3. Making arithmetical computations.
4. Drawing diagrams.
5. Changing from bright light to read scales and back to fluoroscopic work.

Attention has therefore been directed to such accessory devices and organization of steps as would tend to eliminate these contributing sources of error.

In limiting the number of methods for which provision is made there is no intention of denying that others may be equally useful and accurate, and it is no criticism of the methods or their advocates that they have not been selected. It was deemed more desirable to have a few methods for which careful provision had been made and in which men could be well drilled, but it is entirely optional with the roentgenologist which method he will use in any given case. It would be impossible to provide apparatus for all the methods that might have been proposed or advocated.

Reference to the standard methods has been made by letters instead of by the names of those responsible for their development. This is not done with any idea of detracting from the credit of the authors or of indicating novelty, since no claim of priority is made or desired, but simply because descriptions vary in the literature and might be quite confusing to the reader who tries to follow directions that do not apply to our apparatus.

Before discussing the various methods in detail, it may well be pointed out that refined mathematical accuracy is not generally a requisite for good service in this connection. As was remarked by Major James T. Case, Director of Roentgenology of the American Expeditionary Forces, "This war is not being fought with bird shot and a localization, as a rule, to ½ cm. will be entirely satisfactory." In a few cases, such as bodies in the eye or where a small foreign body is in a particularly dangerous and troublesome place, greater accuracy may be required, but it is necessary for the surgeon to keep in mind the fact that because of the incision and the introduction of retractors there may result a considerable displacement of the projectile and it is often difficult to connect its position with displaced skin marks. It may also be remarked that in the majority of cases a certain amount of anatomical localization should be given by experienced and well-trained roentgenologists which in many cases may be of greater value than a simple depth determination. Whether or not this is well done will determine to a considerable extent the value of the *x*-ray service, and every opportunity should be given the roentgenologist to ascertain the landmarks used in surgery and to adapt his work to the requirements of the surgeon using his data.

The various localization methods may be divided into two distinct groups. In the first of these a mark is made upon the skin and the distance of the projectile from this mark is determined. It is generally assumed that the skin mark was made at the place of emergence of the beam which formed a shadow of the projectile and that the tube focus was adjusted vertically beneath the projectile. A vertical line drawn later through the skin point can only strike the projectile if the body of the patient is placed in the same position on the operating table as it occupied during the *x*-ray examination, and careful distinction must be made between a vertical line as so described, and a line perpendicular to the surface of the skin at the marked point. The amount by which the surgeon may miss the projectile by failure to get a correct sight line increases materially with increased depth of the projectile and with decreased dimensions, and some idea of the size of the body sought should always be given. Much greater care will surely be needed in the localization of the smaller bodies.

In the other group of methods some material guide is given to the surgeon to assist him during operation and as a rule these require more time, both on the part of the roentgenologist and the surgeon's assistants. They are naturally better adapted to the work done in the permanent or base hospitals.

After receiving reports from both surgeons and roentgenologists abroad, and after conference with Major James T. Case, Director of Roentgenology of the American Forces in France, in which appliances and methods were carefully considered, it was decided by the Surgeon General's Office to adopt and provide apparatus for the following methods:

A. Two wire, double tube shift method.

B. Parallax method.

C. Tube shift method with mechanical triangulation.

D. Profondometer.

E. Hirtz compass with accessory devices.

F. Cannula and trochar with harpoon.

It happens that the first three of these are simple depth measurements, although B may give more than one depth, whereas the last three may be used to give more definite guidance to the surgeon during operation.

Brief descriptions of these methods will probably suffice excepting for those who are to specifically undertake the *x*-ray work and they will find detailed instructions in the revised *Army X-Ray Manual* which is shortly to be issued.

It is assumed that the majority of the work will be done with the standard *x*-ray table by fluoroscopic methods and with the tube below the table. The tube box is movable in two directions as in the usual trochoscope and is provided with a double shutter giving a diamond-shaped opening with the diagonals parallel and perpendicular to the length of the table and also with an adjustable slit, under separate control, parallel to the length of the table. The tube box runs freely and may be locked in any position against both lateral and longitudinal movement, and is also provided with a simple means for fixing the amount of tube shift for a particular purpose or for measuring any shift from a fixed position.

The fluoroscopic screen is carried by a ball bearing carriage mounted on the table rails and provision is made for a movement parallel to the table, for rotation about a vertical axis and also for a vertical shift. Each of these movements may be prevented by a suitable, convenient lock. The fluoroscopic screens are perforated with a small hole through which a marking device may be inserted to mark the skin in the vertical ray. When this ray is spoken of it is assumed that the table will be substantially in a horizontal position and that a line joining the target with the center of the diaphragm will be perpendicular to the plane in which the tube may move. The opening in the screen also serves a very convenient purpose in temporarily fixing in position the scales and other pieces of apparatus which it is desired to use on the fluoroscopic screen.

METHOD A. Probably the most generally used fluoroscopic method is that designated in our work as Method A. This method was proposed since the beginning of the war by Professor Strohl of the French Roentgenological Service. It is extremely rapid, reasonably accurate, and, as it requires a minimum of manipulation it is likely to be the method of preference for work in the evacuation hospitals. In this, as in the other methods here described, it is assumed that the standard apparatus adopted by the *x*-ray division of the army will be used.

The apparatus supplied for the standard equipment includes a substantial brass frame, carrying two wires firmly attached across two opposite corners and protected by a thin sheet of aluminum. These wires move with the tube box and when the diamond-shaped shutter is wide open they would cast shadows upon the fluorescent screen and these shadows, of course, move with the tube box. After bringing the shadow of the projectile to the center of

the fluoroscopic screen and marking the skin through the opening provided, the operator places in position a small celluloid scale with two sliders. He then shifts the tube until the shadow of one of the

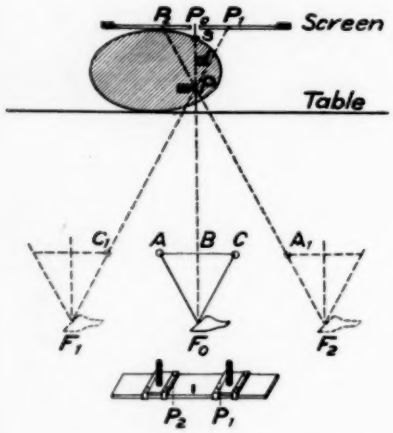

FIG. 1. PRINCIPLE OF THE METHOD A ABOVE. SIMPLE SLIDER FOR MEASUREMENT OF THE DISTANCE BETWEEN THE TWO IMAGES SHOWN BELOW DIAGRAM.

wires carried by the box coincides with the now displaced shadow of the projectile and adjusts one of the sliders to mark this position; then shifting in the opposite direction and leaving the first slider and the center of the device fixed, the shadow of the other wire is brought to coincidence with that of the projectile and the second slider fixed accordingly. The distance between these two markers is in a definite proportion to the distance from the fluoroscopic screen to the projectile in question, and by means of a properly designed scale the depth in centimeters and fractions of a centimeter can be read directly. In case the central point of the screen is not in contact with the skin where a mark is made, it will be necessary to correct for the distance between the skin and the screen. This is not necessary when the point marked is actually in contact with the horizontal screen.

On account of its extreme simplicity and the fact that only a single measurement has to be made, and that the target-screen distance need not be known, this method has been placed first in order of preference.

The principle of method A is illustrated by Fig. 1, which shows a vertical section through the foreign body P, and the target focus F_0. B is the foot of a perpendicular from F_0 on the line AC. A and C are the two metal wires rigidly attached to the tube box and equidistant from B. Let P_0 be the shadow of P by the vertical ray. If we shift the target parallel to the screen and to the left, both A and C being fixed to the box, they must move with it and at a certain point F_1, C_1 and P will fall on the same line, and the shadow of C in the position C_1 will coincide with that of P at P_1. Likewise, shifting the target to the right will bring A_1, F_2 and P into the same straight line, F_2PP_2.

Since F_1P_1 is parallel to F_0C,
F_2P_2 " " " F_0A,
and P_2P_1 " " " AC,

the triangles F_0AC and PP_1P_2 are similar. Consequently P_0P = depth of P below $P_0 = d$, is in the same proportion to P_1P_2 as BF_0 is to AC. Or we may write,

$$\frac{\text{Depth of projectile}}{\text{Image shift}} = \frac{\text{Height of } B \text{ above } F_0}{\text{Distance between } A \text{ and } C}$$

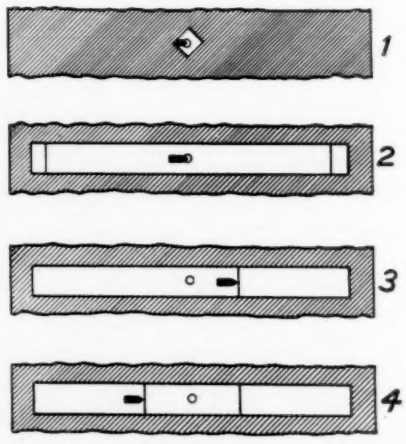

FIG. 2. SUCCESSIVE APPEARANCES ON FLUOROSCOPIC SCREEN IN METHOD A.

(1) Shadow of projectile with small diaphragm at the central point of the screen. (2) Rectangular diaphragm replaced by slit opening, shadow of wires at right and left. (3) Tube has been shifted to the left, bringing the shadow of the projectile and the right hand wire to coincidence. (4) Reverse shift of the tube bringing left wire and projectile shadow to coincidence.

The latter ratio is constant and is fixed in the set-up on the regular army *x*-ray table.

Hence d = image shift multiplied by a constant, k, that is

$$d = P_1P_2 \times k.$$

If we read P_1P_2 in centimeters and multiply by k, d will be found in centimeters.

The special sliding markers, described above, are shown in Fig. 1. The center pin drops into the hole in the lead glass and prevents slipping.

To avoid multiplication a special scale is provided. The distance, P_1P_2, read on this scale gives the required depth. This scale is *not a centimeter scale*, but the readings give depth in centimeters and fractions thereof for a proper height adjustment of the tube.

Fig. 2 shows screen shadows in steps of this method. In 1 is seen shadows in central ray; 2 shows open slit and shadows of wires; 3 shows coincidence of shadow and right hand wire, and 4 points for measurements.

METHOD B. This method utilizes the optical principle of parallax and may be carried out with extremely simple apparatus, although a more elaborate device has been provided. If one observes the shadow of a projectile upon the fluoroscopic screen,

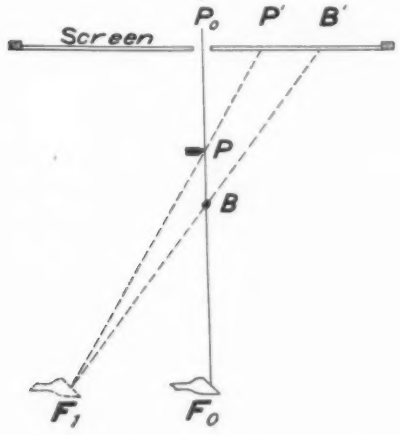

FIG. 3. PRINCIPLE OF THE PARALLAX METHOD.

Auxiliary body, B, below P and distal from the screen shows greater shadow displacement to B'.

while the tube is moving and the projectile is very close to the screen, the shadow movement for a given tube shift will be very slight and the farther the body is removed from the screen the greater will be the extent of the shadow motion. If we ad-

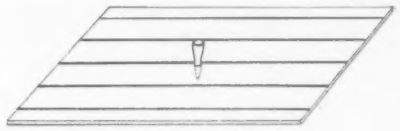

FIG. 4. RULED CELLULOID SHEET TO INDICATE EQUALITY OF MOTION OF TWO SHADOWS IN METHOD B.

just a suitable opaque body outside of the patient until its shadow moves the same distance for a definite tube shift as was moved by the shadow of the projectile for the same tube displacement, the auxiliary body must then be as far from the screen as the projectile whose depth is sought.

In the case of a projectile in the abdomen, so far from the lateral boundary of the body as to preclude simultaneous observation of the indicator shadow and that of the projectile, the adjustment of the latter may be made after the patient has been removed, *provided the screen has been locked against vertical motion* so as to remain at the same distance from the target as before. Generally, however, the indicator may be moved up and down in a plane, passing through the projectile and perpendicular to the axis of the body, close enough to the patient to permit free motion and allow both shadows to be seen at once.

By means of parallel lines ruled on a transparent piece of celluloid it is fairly easy to ascertain when equality of motion of the two shadows is secured. In the more complete apparatus furnished for this work, Fig. 5, it is possible to mark the skin at the entrance and emergence point of the vertical ray and also along a continuation of the rod carrying the special indicator. This really gives three independent depths with some corresponding advantage to the surgeon.

The principle of this method is shown in Fig. 3 where

F_0P_0 represents the vertical ray,
P " " foreign body,
B " an auxiliary body opaque to the rays and adjustable at will.

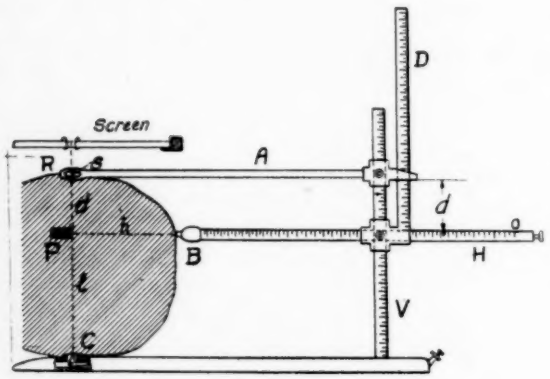

FIG. 5. SCHEMATIC DRAWING OF THE BLAINE MODEL PARALLAX LOCALIZER.

The shadows of P and B are shown as though they were in the plane of the paper, but this is not the actual case, as B will be quite outside this plane.

If, now, the target is moved toward the left to F_1, the shadows appear at P' and B', and P_0B' is greater than P_0P' if B is farther from the screen than P.

By raising or lowering B a position may be found where, on shifting the tube, the shadow of B and P move at the same rate. Then B and P are the same distance below the screen. The ruled sheet of celluloid, Fig. 4, is a convenience in making sure that P and B move the same amount when a convenient tube shift is made.

Apparatus.—The apparatus may consist essentially of the following parts, Fig. 5.

A base of suitable size carries a vertical post, V. Sliding on this post are two rods at right angles to P that may be adjusted vertically at will. The upper of these is not adjustable laterally so that the ring, R, is at a fixed distance from the upright, V. The other rod carries a ball, B. This may be perforated to permit of a projecting skin marker. B may be shifted in two directions at will. When adjusted so that its shadow moves at the same rate as that of P, when the tube is shifted, the distance between the rods, d, is the depth of P below the ring, R. This is true independently of the screen position.

By using three scales, D, H, and V, we may find the distance from the skin to P in three directions, viz., PR, PB, and PC. In all cases d and h should be observed and R and B marked. If the opening in the base, C, is used in centering, RC and PB are at 90°.

METHOD C. The single tube shift method with triangulation has appeared in a great variety of forms. Some of these involve the drawing of diagrams and the use of algebraic computation. In many cases the apparatus was designed to work at a fixed tube screen distance, which has certain disadvantages. The principle of the method is shown in Fig. 6.

Let F_0 be the target in such a position that the vertical ray at right angles to the plane of the tube movement projects the shadow of the foreign body, P, on the hole in the screen.

Shifting the tube to F_1, there will result an image shift to P_1,
and the triangles P_0P_1P and F_0F_1P are similar. Also F_1QP_1 is similar to each.
Therefore $\frac{P_1Q}{F_1Q} = \frac{PP_0}{P_0P_1}$ or $PP_0 = P_0P_1 \times \frac{P_1Q}{F_1Q}$
i.e. depth of foreign body = image shift $\times$ target-screen distance divided by sum of tube shift and image shift.

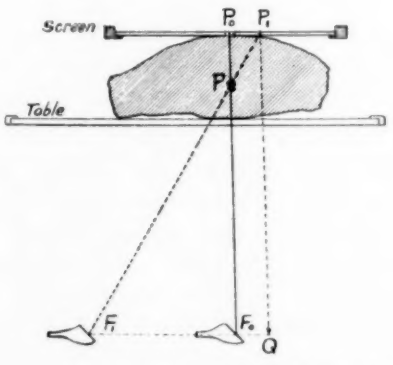

FIG. 6. PRINCIPLE OF THE SINGLE TUBE SHIFT METHOD.

Where no auxiliary apparatus is supplied, one must measure the various lengths by a scale and make a numerical computation. This may be made easier by the use of special devices.

1. One may use a fixed tube shift of 10 or 15 cm. or an image shift of an exact number of centimeters.

2. One may use a fixed target-screen distance. This is not, however, always convenient.

3. One may reproduce the exact set-up of Fig. 6 by use of a device as shown in Fig. 7 and which may be supplied in case of a desire to use this method.

This consists of two straight bars, *A* and *B*, at right angles to each other. *B* carries an adjustable slider, *R*. *A* carries two sliders, *E* and *G*. *E* is not moved after one adjustment unless a new table is used. The slider, *G*, has notches, 1, 2, etc., 1 cm. apart, and a slider, P_1, with a latch engaging these notches. A scale, *S*, with its zero point at the upper end is carried by *G*. A lug at *H* is in line with the zero of *G*.

If, now, *DH* = tube shift,
GH = target screen distance,
P_1O = image shift,
then a straight line, P_1D, will cross the scale, *S*, at the depth of the foreign body below the screen. The instrument should be fastened to the wall in a convenient place and the measurements needed should be made by a caliper, thus avoiding any reading of scales except the final depth.

If in the particular case illustrated, the image shift were 4 cm. and the zero point of scale, *S*, is set above *H*, an amount equal to the target-screen distance, and *DH* is the tube shift for an image shift of 4 cm., a string drawn as indicated will cross the scale at a point *P* and the scale reading at this point is the depth sought.

When using the standard table the slider, *E*, is adjusted so that a length measured on the screen-carrier support will show how much above *E* we must place *G* in order that *GH* may represent the target-screen distance.

It will be observed that this instrument serves to reproduce tube and image positions as actually observed by the roentgenologist; i.e., one vertical ray in which the skin is marked and one oblique ray whose intersection with the former corresponds to the distance of the projectile from the screen.

An accessory device is also supplied consisting of a strip of celluloid with a pin centering in the perforation of the screen and having centimeter divisions clearly marked both ways from the center, making it quite easy to secure an exact number of centimeters displacement.

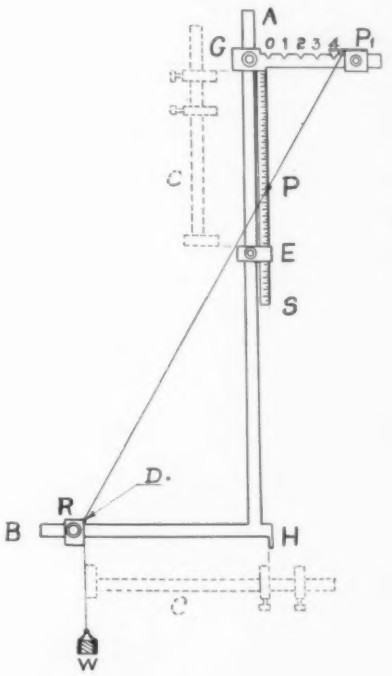

FIG. 7. WALL METER OR INDICATOR FOR TUBE SHIFT METHOD, ALSO SHOWING METHOD OF USING ADJUSTABLE DOUBLE SLIDER CALIPER.

There is a considerable advantage in making the distance the image is shifted a definite number of centimeters and measuring the tube shift, since the relative error in measuring the small length of image shift is greater than that in the longer tube shift.

When supplied with the accessories indicated above, this method becomes as

expeditious as others, and is as accurate as any of the depth methods. The exact details of manipulation are, of course, given in the regular *Army X-Ray Manual.*

All of the second group of methods require somewhat different manipulation and

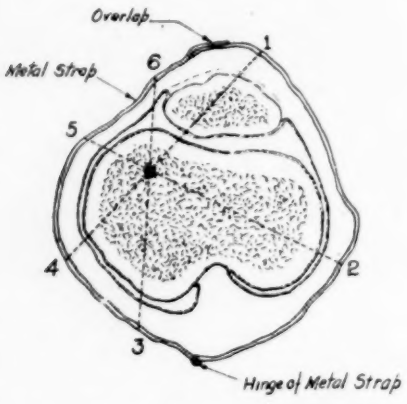

FIG. 8. PRINCIPLE OF PROFONDOMETER STRIP.

an added amount of data which may give the surgeon rather more definite indications and assist him materially in many cases.

METHOD D. This method has been described by Major Joseph M. Flint in *The Military Surgeon* of March, 1917, and while the method is not new in principle it had not been generally used heretofore, as apparatus for its application was rarely available. It consists essentially in securing three lines of sight through the body, each of which is to pass through the projectile. The points where the rays enter and emerge in establishing these lines are plainly marked on the skin. Two pieces of flexible metal, such as a composition of tin, are hinged together in the middle and placed around the body in the plane of the skin marks and made to conform to the shape of the body. The strip is marked, showing the distance that one unhinged end overlaps the other, and the skin marks are transferred to this metal band. Carefully removing the latter from the body, it may be laid down on a card or a sheet of paper, and by bringing the overlapping end to its original position a tracing with a pencil will show the outline of the body in the plane of examination. The skin mark positions are then transferred to the diagram and we have an approximate duplicate of the shape of the body and the locations of the external skin markings.

If, on this diagram, Fig. 8, one numbers the skin marks in series 1, 2, 3, 4, 5, and 6, and joins 1 and 4, 2 and 5, and 3 and 6, and if the work has been strictly accurate, that is, if the sight lines were properly established, and if the shape of the body did not change by change of position when the band was put on, supposing the band has been properly formed and not distorted afterwards, these three lines will intersect in a point; practically they are likely to form a small triangle, but with an excellent chance of the projectile being located in this small area. If one now identifies the diagram, so formed, with a cross section anatomy for the same region of the body, definite anatomical information as to the position of the projectile and the relative position of muscles or organs likely to be encountered in its removal is gained.

It is also possible to use two short bands at right angles to each other, that may be made to conform to the body at a desired point, and to mount an indicating rod for use during operation.

The value of this method will depend to a considerable extent upon the care exercised in forming and handling the strip and in properly adjusting it to the cross section anatomy. It is suggested that in many cases at least one of the skin marks might well have definite relation to some anatomical landmark, so that there could be little opportunity for a rotation of the band with reference to the anatomical chart. This will be especially true of portions where the cross section is nearly a circle. It should also be observed that the accuracy of this method increases when the three sight lines are made to differ materially in direction. In some cases this would be a difficult matter, as in the case of a seriously wounded patient or one for whom change of position on the *x*-ray table is painful.

It is advised in every case that three lines of sight be determined, marking six skin points, and for this purpose the parallax localizer furnished in the army outfit will be found very valuable, as it permits of marking the skin on the under side with the same degree of certainty as on top. It may be noted also that the method here described eliminates the necessity of using more than one distinctive skin mark, and it would do no harm, when using this method with a parallax localizer as a marking device, if at least one depth were determined as a check upon the accuracy of adjustment of the profondometer band.

Those who are especially interested will find articles by Major Flint giving more details with reference to this method in *The Military Surgeon* of March, 1917 and the *Annals of Surgery* for August, 1917.

METHOD E. There have been devised both before and during the war a very considerable number of mechanical indicators or compasses to be used during the operation as a surgical guide to better utilize information acquired by the *x*-ray examination. Of these, the one devised by Dr. Hirtz of the French Roentgenological Service has been most generally approved by roentgenologists and surgeons.

As originally proposed this instrument was intended to be used in connection with photographic work, whereby a permanent record could be made for the later setting of the compass, provided the identifying skin marks were not obliterated. On account of the very considerable time necessary to prepare a negative for examination and measurement, it has been found desirable in many cases to operate the compass by data secured from fluoroscopic examination, which is much more expeditious and in many cases will serve fully as well.

The essential feature of the Hirtz compass is the possibility of adjustment of the movable legs that support the instrument, so that when resting on fixed marks on the body of the patient the foreign body will be at the center of a sphere, a meridian arc of which is carried by the compass. This arc is capable of adjustment in any position about a central axis. An indicating rod passes through a slider attached to the movable arc in such a way as to coincide in

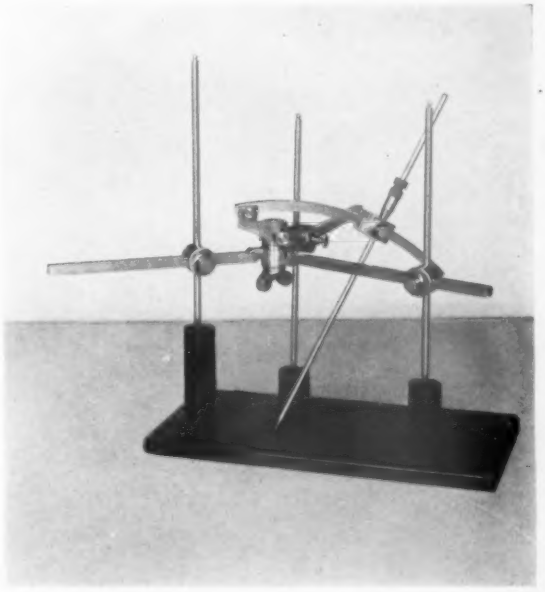

FIG. 9. HIRTZ COMPASS.

all positions with a radius of the sphere, and whether it actually reaches the center or not it is always directed toward that point. If its movement to the center of the sphere is obstructed by the body of the patient, the amount it lacks of reaching the center will be the depth of the projectile in the direction indicated by the pointer.

The value of the compass lies in its wide possibility as a surgical guide, in that it does not confine the attention of the surgeon to a single point marked on the skin, with a possible uncertainty as to the direction in which he should proceed in order to reach the projectile, but gives him a wide latitude of approach and explicit information as to depth in a direction of his own selection.

The compass is shown in Fig. 9 and schematically in Fig. 10. Three metal arms respectively labeled 1, 2, and 3 in clockwise rotation are so mounted as to turn freely

upon a central pivot and have their upper surfaces all in a single plane. Each of these arms carries a slider, which may be adjusted to any position along the length of the arm. Each slider has an adjustable leg

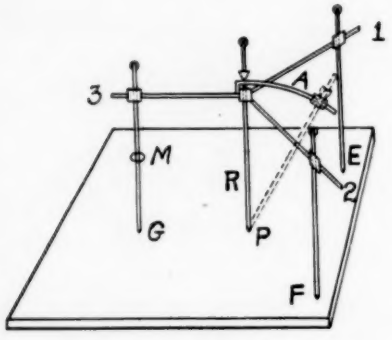

FIG. 10. SCHEMATIC DRAWING OF HIRTZ COMPASS WITH THE LEGS ADJUSTED AT ZERO POINTS AND RESTING ON A PLANE.

at right angles to the plane of the arms, that may be held in any position by a small thumb screw. These legs are graduated and the zero point is not at either end of the legs, but a few centimeters below the upper portion, which terminates in a small knob. The center post about which the arms rotate has a hole at right angles to the plane of the arms and is also shaped to carry the curved metal arc, *A* (Fig. 10). The hole in the slider on arc, *A*, carrying the indicating rod, can be made to coincide with the opening through the center post.

When the three legs are set at zero, quite irrespective of the position of the slider on the arms or of their angular position, and the compass stands on a plane surface, the indicating rod, passed through the slider on arc, *A*, will touch the supporting plane at the center of the sphere of which *A* is a meridian arc. A friction clip on the indicating rod may be adjusted in contact with the slider on *A*, and the distance from the lower end of this clip to the pointed end of the indicator will be the radius of the sphere of which *A* is an arc.

Fig. 11 shows the compass with the legs shifted so that they no longer stand on the base plane, and in fact are at quite different heights, but the arc, *A*, and the arms of the compass have *not been displaced*, so that the pointer still reaches the center point, *P*, in this plane.

Fig. 12 shows the compass actually set upon the body of a patient, its legs resting on three skin marks, *M*, *N*, and *O*, and with the indicating rod pointing toward the projectile, but failing to reach it because of contact with the skin of the patient at *S*. The depth of the projectile in this particular direction is indicated in Fig. 12 by *d*. If, now, the indicating rod is placed in the slider carried by the arc, *A*, the rod touches the skin at a different point, *S'*, and the distance between the friction clamp on the rod and the upper surface of the slider on the arc, *A*, will be the depth of the foreign body along the direction indicated by the dotted line. It is evident from the construction that the surgeon may place the arc, *A*, in any position throughout 360° and the slider at any position from the center to the extreme end of the arc and still have the indicating rod point to the foreign body and show its depth from the point of contact with the skin.

The exact amount which each leg of the compass must be shifted from its zero point in order to stand on the marker to which it belongs and yet have the indicating rod in the proper position is easiest seen in Fig. 13 in which only a single leg of the com-

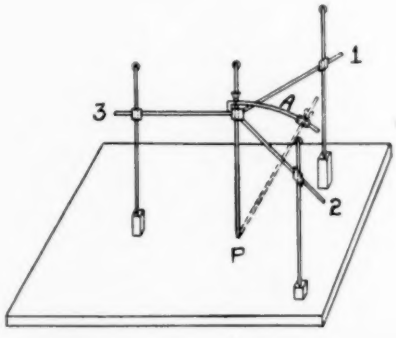

FIG. 11. ARMS AND INDICATOR OF THE HIRTZ COMPASS.

Same position as in Fig. 10, but with the legs elevated on blocks whose tops might correspond to a skin marker.

pass is shown, but the same will apply to each of the legs in turn. Imagine a plane parallel to the plane of the three arms of the compass to be drawn through the projectile and that the leg attached at arm number one, standing on the marker, *M*, would, if it could pass down to this plane, intersect the plane at the point, *E*, and that under these circumstances the indicator passing through the central post of the instrument would touch the skin at *S*, vertically above *P*. If the distance from the plane, from which measurements are made, to the lower plane, containing the projectile, is measured and likewise the distance *MM'*, it is seen that the amount by which this particular leg is raised from its zero point, where it would be set if it reached the point, *E*, will be the difference between the depth of the foreign body and the depth of the marker from *any plane of measurement*, for example, that of the fluoroscopic screen or a photographic plate. The fluoroscopic screen may be placed in any position parallel to the base plane, *EP*, and the difference, *ME*, would be quite independent of the height of the plane from which *all measurements* are made.

This may be summarized by saying that each rod is to be shifted from its zero point an amount equal to the *difference* between the depth of the projectile below the fluoroscopic screen, or other plane of reference, and the depth of the skin mark upon which this particular leg would stand, measured from the same plane. It is absolutely essential in the use of the compass to adopt a systematic procedure, so that the arm to carry the leg is identified with the depth measurement of its own skin point.

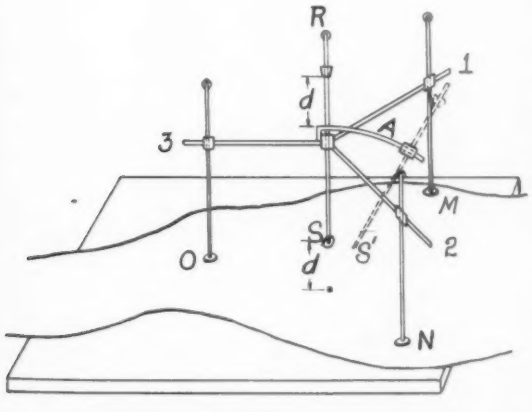

FIG. 12. SCHEMATIC DRAWING OF HIRTZ COMPASS SET UP ON SKIN OF PATIENT.

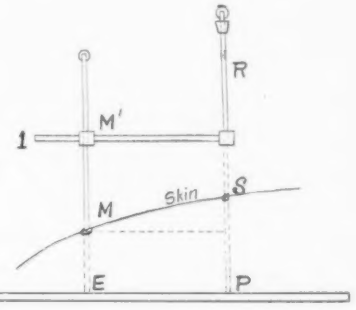

FIG. 13. REASON FOR SHIFT OF LEG OF COMPASS FROM ZERO POINT BY THE AMOUNT STATED.

The data necessary to properly adjust the compass may now be stated by reference to Figs. 10 and 13. The indicating rod in the central position and the three legs of the compass mark out, in any plane parallel to the base plane of Fig. 10, four points of definite position in the plane. Any vertical shift of the legs will still allow them to retain their position in lines passing through the points, *E*, *F*, *G* and *P*. The point *G*, Fig. 10, is then in a vertical line passing through the marker, *M*, and the data necessary to set the compass must give the position in a plane of these four points and, in addition to this, must give the depth from a fixed plane, parallel to the base plane, *E F G*, of the three markers on the skin of the patient and of the projectile within the patient's body. Whether this data is to be found by a photographic or a fluoroscopic process is immaterial, as the steps in its use will be identical.

When a fluoroscopic method is to be used, an auxiliary device may be found of considerable aid in rapidly and accurately securing the requisite data. Such a device is shown in Fig. 14 (a) and consists of three arms, each with a slider very similar to the

original compass. In fact the latter may be used with rather less convenience, by removing arc, *A*, and allowing the indicating rod to project a short distance below the center and with the legs temporarily removed. The auxiliary compass has its arms numbered in the same way as the original Hirtz compass and has a projecting pin which fits the perforation in the screen. One of the arms is rigidly attached to a ring concentric with the axis of rotation about the pin, while the other two are movable, but may be clamped by thumb nuts to the ring. It is evident that placing the perforation in the screen in the vertical ray passing through the projectile definitely fixes the position of the center post. If then, each marker in turn is brought into the vertical ray and the arm and slider adjusted so that the hole in the slider matches such a projection of each marker, the three openings in the sliders and the central pin fix the four points which it is necessary to obtain. It then remains to determine the depth of the projectile, for which one of the methods, *A*, *B*, or *C*, should be employed and also to determine the distance from the screen to the opaque markers. When using the fluoroscopic method, the latter depth can be very readily determined by simply passing a suitable measuring rod through the perforated screen, which has been brought into the vertical ray passing through the marker. This depth is to be recorded and accurately identified with the arm carrying the slider corresponding to that particular skin marker. In order to facilitate this measurement a set of three measuring rods with friction clips, differing slightly in shape, are provided. As soon as these four depths and the four marks in the plane of the screen have been determined, the work of the roentgenologist is completed, provided he has made sure that the skin marks are plainly visible. The adjustment of the compass may then be carried out by an assistant to either the roentgenologist or the surgeon, after which

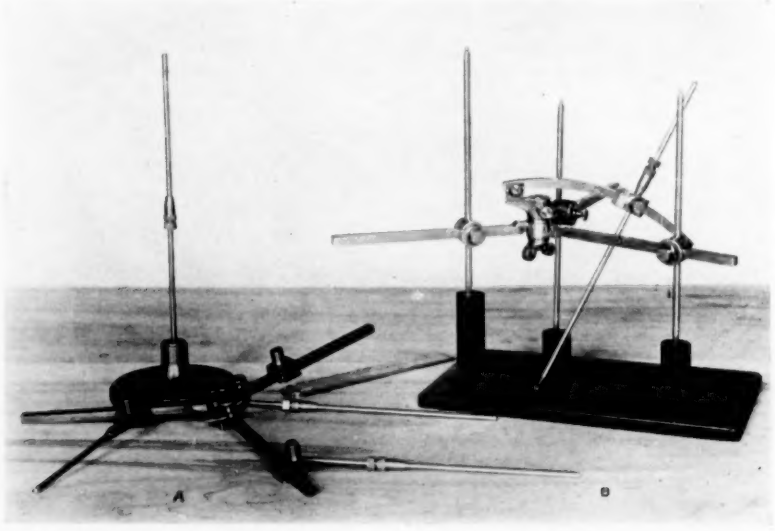

FIG. 14. ACCESSORY APPARATUS FOR FLUOROSCOPIC WORK WITH HIRTZ COMPASS.

(a) Auxiliary compass, pedestal support and three markers with friction clips.
(b) Hirtz compass mounted with the three legs at different levels, so that a pointer reaches white spot on the base plane below at the center of the sphere of which the curved arc is a part.

the instrument can be sterilized and is ready for the surgeon's use.

In making this adjustment the operator must first bring the central opening in the shaft of the compass over the projection P_0 of the projectile in the fluoroscopic plane, and this must be retained in that position during the adjustment of the arms. It is advised that a small hole in a drawing board be provided in case the adjustment is to be made from a diagram and that P_0 be brought over this opening and the paper attached by thumb tacks or otherwise to the drawing board. Then each of the sliders on arms 1, 2, and 3 are to be brought into position, so that the feet of the compass rest on the projections of the markers. After tightening the thumb nuts on the sliders and the wing nut at the center of the compass, which is used to lock the arms in angular position, one should again see that these feet are adjusted to the proper points. Next, bring each leg so that its zero point coincides with the top of the slider by which it is carried. Then, for each leg, subtract the depth of the skin marker from that of the foreign body and adjust the corresponding leg from its zero point by the number of centimeters so obtained, being sure to lock each leg in position. The compass is then ready for use by the simple attachment of the curved arc and the indicator, provided the skin marks which indicate its proper position are not, in the meantime, obliterated. Probably the best way to insure the permanence of these marks is to tattoo them, which may be done by simple apparatus and not be undesirably conspicuous.

When using the special adapter provided with the army outfit, if the compass is to be used at once it may be very quickly adjusted as follows:

1. Remove curved arc and indicating rod, lower each leg until the rounded end is about a centimeter from the slider, and loosen the central lock.

2. Invert the compass and place upon the inverted adapter so that the pin on the adapter engages the central opening of the compass.

3. Adjust each leg in turn to engage the small opening in the sliders on the adapter.

4. Lock all the sliders on the arms and the central lock of the Hirtz compass.

5. Turn the compass right side up and put it on the stand provided, having previously firmly adjusted the sliding clip on the vertical rod of this stand, so that when the compass is placed thereon and the legs loosened in their holders, all three legs will come to their zero, if the base stands on a plane surface.

6. Leaving the compass supported by the stand, adjust each rod as previously indicated, always starting from its zero point.

When the operation is to take place a considerable period after an *x*-ray examination is made, a suitable record must be entered as a part of the temporary record of the patient and care must be taken that it is accurately labeled, so as to be identified with certainty at the time of operation.

When using the Hirtz compass roentgenographically two exposures are necessary, either made upon a single plate which remains in a fixed position relative to the patient while the tube is shifted, or else two plates may be used with proper markings, one being exposed with the tube in the first position, the other in a second position. The use of the two plates is recommended and in order to superimpose them for the purpose of measurement a small piece of celluloid, which may be attached to the tunnel plate changer, is used and carries two small metal wires forming a cross; when these crosses are made to coincide on superimposing the negatives, the proper measurements may be made.

In order to explain the procedure necessary in this case reference is made to Fig. 15, in which is shown the position of the tube for two successive exposures with reference to the plate and the formation of the shadows of one of the skin markers. It should be noted that each skin marker and the foreign body will be projected in the same way, only the displacement of their shadows in the two exposures will differ according to their distance from the plate.

In the method approved, the distance, CX, from the central position of the tube to the plate in the vertical direction is to be 60 cm. and the tube shift, F_1F_2, is to be 6 cm., that is, from a point 3 cm. to the left of C, to a point 3 cm. to the right of C. For this arrangement a table is supplied which gives the height of a point above the plane of the plate, corresponding to any probable shift of image measured on the completed negative, that is, Fig. 15, for a measured M_1M_2 there is given the height MM_0.

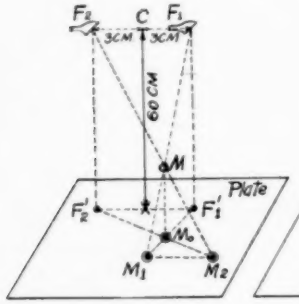

Fig. 15.

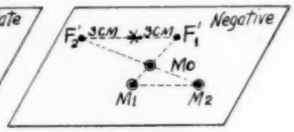

Fig. 16.

Fig. 15. Schematic Representation of Plate, Cross Wire Marker and Tube Focus Positions for Radiographic Use of the Hirtz Compass.

Fig. 16. Construction for Finding One of the Foot Points M from the Shadows of a Corresponding Marker as Shown at M_1 and M_2 and the Shadow of the Cross Marker, X.

The reason for the procedure given with reference to measurements on the negative may be shown as follows:

Let X be the crossed wire marker at the center of the plate; CX a perpendicular to the plate at X and C the level of the tube focus. If M is one of the markers on the skin, it is required to determine M_0, the foot of the perpendicular dropped from M to the plate, and the height M_0M.

According to instructions the exposures are made with the focus at F_1 and F_2 where $F_2C = F_1C$. The shadow M_1 is cast by M when the focus is at F_1. If we draw F_1F_1' perpendicular to the plate, the plane, $F_1M_1F_1'$, is perpendicular to the plate and passes through M. The same is true of $F_2M_2F_2'$. From this it follows that the line of intersection of these two planes, MM_0, is also perpendicular to the plate.

But $F_2'F_1'$ is parallel to F_2F_1 and of equal length. Also M_1M_2 is parallel to F_2F_1 and therefore to $F_2'F_1'$. This at once gives the construction of Fig. 16. There appears on the negative the shadow of the marker X and the two shadows of M at M_1 and M_2. Hence, join M_1 and M_2 and draw a line through X parallel to M_1M_2. Mark one half of the tube shift on each side of X on the line so drawn as F_2' and F_1'. Join M_1 and F_1' also M_2 and F_2'. Then M_0, the intersection of these two lines is the foot point sought.

Measure M_1M_2 in centimeters and fractions thereof and find this length in column marked displacement in the table for this setting and opposite this number read the height of marker or projectile above the plate.

Fig. 17 shows the full chart construction for the feet 1, 2, 3 and the center rod P_0.

The only difference between the plate method and the fluoroscopic is that in the former the reference plane is below the patient and in the latter it is above. The method of setting the compass is the same in each case.

Fig. 18 shows the compass in position on the patient at operation.

Method F. This method is one that has been known under various designations and attributed to a variety of authors. It may be described as the method of direct

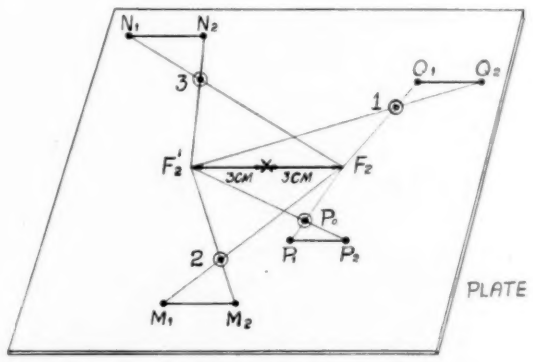

Fig. 17. Complete Chart for Setting Feet of Hirtz Compass.

approach through the skin and tissue to the foreign body, under fluoroscopic guidance, or, according to the apparatus used, as the method of cannula and trochar. While the method has been advocated by some excellent surgeons and has naturally given good results in many cases, it is regarded by the Service as the least desirable of the methods adopted and it is urgently advised that it should never be used excepting in the hands of an operator who will either work under the direct supervision of a competent surgeon or anatomist or who has acquired that degree of anatomical knowledge and surgical judgment which would permit of its use without danger to the patient.

The illustrations in various publications showing the introduction of the instruments at an angle with the line of sight should be completely forgotten, as this method is bound to result in a considerable mutilation of the tissue before one is likely to come in contact with the projectile.

In using the standard army outfit, one should bring the target vertically beneath the projectile, stop down the diaphragm to a moderate size and lock the screen against all excepting vertical motion, with the central perforation in the vertical ray passing through the projectile. Then insert the cannula and trochar through the perforation in the screen and after puncturing the skin press slowly and carefully down in a strictly vertical direction until either contact with the projectile is felt or vision at two slight angles indicates that contact has been made. After this remove the trochar and pass the hooked piano wire or harpoon through the cannula, being sure that it passes beyond the end of the tube and that it is not withdrawn on removal of the cannula. While inserting the cannula it will best be held by use of a strong pair of forceps as provided. These may lie flat upon the fluoroscopic screen and, in this way, keeping of the cannula in a vertical position will be somewhat easier. The wire which has been inserted may, if one desires, be cut off a short distance, ¼ inch, above the skin, or it may be bent down close to the skin and, knowing the length of the original wire, the amount projecting gives the surgeon a definite idea of depth.

Fig. 19 shows the complete set of accessories for localization, as supplied and grouped according to the designating letters.

Fig. 18. Hirtz Compass in Position.

Fluoroscopic Assistance During Operation. Several methods have been proposed for the utilization of the fluoroscope at the time of operation, especially where the mobility of the projectile in the tissue and the uncertainty of its position are such as to delay, unduly, the work of the surgeon. The methods so far proposed may be grouped as follows under four heads:

1. The *x*-ray work may be done in the surgical operating room, thus requiring the surgeon to operate in special light which may be extinguished when he desires to examine fluoroscopically.

2. The patient may be returned to the *x*-ray room when the surgeon requires further information.

3. The roentgenologist may be called to the operating room for temporary assistance in pointing out the position of the projectile.

4. The operation may be performed with special forceps while using the fluoroscopic light as a guide.

Each of these propositions has its own

difficulties and its own merits. The objections to the first are the bad fluoroscopic conditions which would be likely to prevail and the fact that the *x*-ray apparatus would be operated at low efficiency, being necessarily delayed by the surgical operation.

In the second, the transfer of the patient back to the *x*-ray room, provided a suitable stretcher top is used, may, of course, be accomplished, but it involves moving the patient back again for operation and the possible displacement of parts during the transfer.

The objection usually raised to number three is the requirement of *x*-ray apparatus in the operating room and the possible danger from sparks igniting an ether-air or chloroform-air mixture. The latter can be avoided either by making the *x*-ray apparatus spark proof or by avoiding these fumes from the anæsthetic in the room. The roentgenologist must be supplied with a bonnet fluoroscope which automatically screens the eyes by suitably colored glasses when he seeks to find his way about a lighted room, and is automatically lifted or removed, when the fluoroscope comes into position.

In this case the process can perhaps be illustrated best by Figs. 20 and 21 showing also the type of indicator used by the roentgenologist and the surgeon; it being understood that the roentgenologist working above the sterile sheet can give an approximate indication, after which the surgeon, using a sterile pointer below the sheet, may, under fluoroscopic guidance by the roentgenologist, insert his indicator until contact is attained, after which the operation may proceed as before.

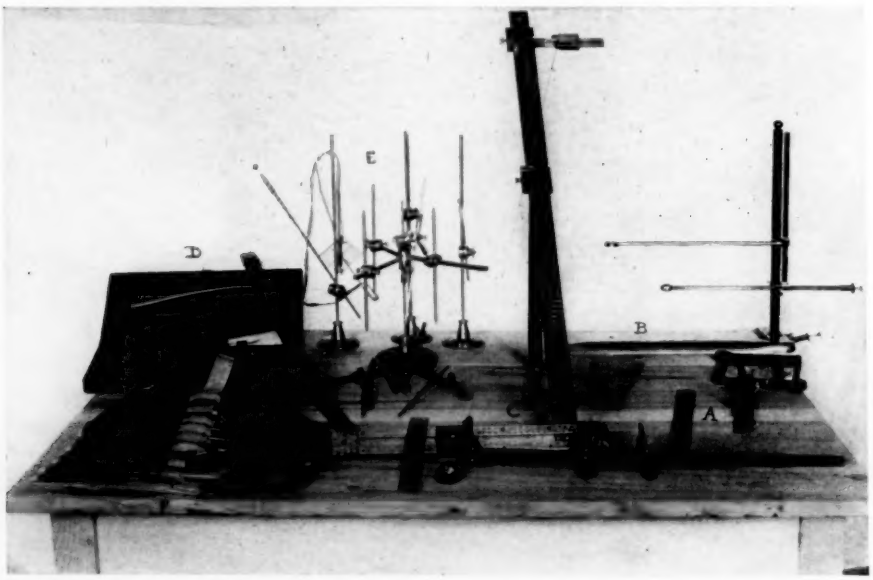

FIG. 19. SET OF LOCALIZATION ACCESSORIES SUPPLIED IN THE REGULAR ARMY OUTFIT.

The fourth method is essentially one for the expert and will probably be of more value when a practical stereofluoroscope is provided.

The following extract from the report of the Director of Roentgenology of the American Expeditionary Forces in France indicates the preparation which will be made for this class of work.

"The ordinary base hospital or portable table regularly furnished by the *X*-Ray Division of the Surgeon General's Depart-

FIG. 20. INTERMITTENT CONTROL.
Roentgenologist with fluoroscope raised ready to lower it and proceed with examination.

ment of the Army will serve admirably for this type of surgery, either operating with the bonnet fluoroscope in the usual bright light of the operating room, or by artificial light of suitable color in the fluoroscopic

FIG. 21. INTERMITTENT CONTROL.
Surgeon and roentgenologist working simultaneously.

room of the *x*-ray department, with proper arrangements for conveniently extinguishing the artificial light, and turning on the current going to the *x*-ray tube. An order has been placed for a hundred extra base hospital tables without the screen support, to be issued to operating rooms for this very purpose, our anticipation being that the bonnet method will be far more popular than the open screen method. We have acquired in France a small supply of collapsible operating tables with aluminum tops, also designed for this special type of roentgenosurgical work. Lacking any of these tables, the roentgenologist will be able to improvise a suitable equipment by combining the bedside outfit with an ordinary

stretcher, resting on the regular stretcher supports which will be available in the field.

"It is anticipated that the usual arrangement will be a base hospital table (without screen support) with overhead wire connections from the neighboring *x*-ray room, or there may be provided a special bedside unit without a tube stand with the tube under the table.

"For operations in the usual light of the operating room, there will be needed a bonnet fluoroscope so arranged that when the roentgenologist is not actually working with the *x*-ray, his accommodation will be preserved by means of dark glasses, which are automatically dropped before his eyes when the hood of the bonnet fluoroscope is turned up; a special metal pointer (*indicateur*) for the roentgenologist, one for the surgeon, and a special forceps for projectile extracting of special design to protect the hands of the surgeon from the *x*-rays. A foot switch will be a help, but in the absence of one, an assistant can turn the current on or off at will. Both hands of the roentgenologist must be free, so that he may be able to work."

The following abstract and table is from an article by J. Metcalf and Keys-Wells in the *Lancet* of May 27, 1916.

Depth of Anatomical Landmarks Beneath the Skin.—Surgeons will find the table given below of value in determining the exact position of a foreign body in relation to points on the skeleton. In the article published with this table, the authors state that the surgeon often experiences many difficulties when operating for the removal of a foreign body even after the roentgenologist has made an accurate localization. Previous to the war, the surgeon studied the ultimate depth of his operation only with regard to certain surrounding anatomical landmarks, and not in terms of centimeters or inches beneath a point on the skin. If the roentgenologist reports a projectile as being 4.5 cm. from a point on the skin of the back overlying the transverse process of the 12th dorsal vertebra, the surgeon has little knowledge as to where this depth will lead him. If, however, the surgeon knows that the average depth of this structure is less than 4 cm. from the skin he appreciates the fact that the projectile must lie in or just anterior to the transverse process. The objection is, of course, that individuals vary greatly in thickness of various parts, but the authors call attention to the fact that the soldier is selected after rigid examination and as a result the extremely thin and extremely obese are not present.

TABLE

HEAD: LATERALLY *Incision*	DEPTH OF ANATOMICAL POSITION
Just above zygoma	1 in. to sphenosquamosal suture
Just below zygoma	1½ in. to sphenoidal bone
To coronoid process or condyle of mandible	1 in.
NECK: ANTEROPOSTERIORLY	
Through center of larynx	2 in. to body of vertebra
1¼ in. to side of center of larynx	1½ in. to transverse process of cervical vertebra
1¼ in. to side of center of larynx	3 in. total depth of neck
Through middle line of trachea just below cricoid	1½ in. to body of vertebra
1¼ in. to side of center of trachea	1½ in. to transverse process of vertebra
From center of suprasternal notch	1¼ in. to posterior border of manubrium
NECK: LATERALLY	
From center of middle of neck.	1½ in. to transverse process of vertebra
From center of middle of neck	2¼ in. to body of vertebra
From just below tip of mastoid process	2¼ in. to body of 1st cervical

	DEPTH OF ANATOMICAL POSITION
CHEST SUPERIORLY	
From a point midway between root of neck and tip of acromion	2 in. to apex of pleura, downwards
From a point midway between internal and external extremities and just behind posterior border of the clavicle	2 in. to apex of pleura, downwards
CHEST: ANTERIORLY	
From center of lower border of clavicle backwards to subscapular fossa just clear of ribs	3 in.
From a point just over tip of coracoid to subscapular fossa backwards	3 in.
From a point 1 in. external to sternoclavicular joint just below clavicle	1 1/3 in. to 1st rib
From a point 1 in. external to sternoclavicular joint just below clavicle.	3/4 in. to pleura
From a point 2 in. external to sternoclavicular joint just below clavicle backwards	1 1/4 in. to 1st rib
From a point 2 in. external to sternoclavicular joint just below clavicle backwards	1 3/4 in. to pleura
From a point 2 in. below center of clavicle	2 in. to pleura
CHEST: POSTERIORLY	
To supraspinous fossa	1 in.
To intraspinous fossa	3/4 in.
To transverse process of 7th cervical vertebra	1 1/2 in.
To pleura level of 7th cervical vertebra	2 in.
To anterior level of body of 7th cervical	3 in.
To transverse process of 12th dorsal vertebra	1 1/3 in.
To pleura level of 12th dorsal vertebra	2 in.
To anterior level of body of 12th dorsal vertebra	3 1/3 in.
ABDOMEN: THICKNESS OF WALL FROM FRONT	
1/2 in. to either side of middle line just above umbilicus	1 in.
1/2 in. to either side of middle line just below umbilicus	1 1/5 in.
Just internal to anterior superior spine to iliac fossa	3 in.
Midway between anterior superior spine and pubic crest to front of acetabulum	2 in.
ABDOMEN: THICKNESS OF WALL FROM SIDE	
On level of tip of 12th rib in line upwards from anterior superior spine	1 in.
ABDOMEN: THICKNESS OF WALL FROM BACK	
To transverse process 3d lumbar	1 3/4 in.
To anterior level of body of 3d lumbar	4 1/4 in.
To anterior level of psoas muscle	5 in.
HIP AND THIGH FROM FRONT	
3 in. below anterior superior spine to head of femur	2 1/4 in.
3 in. below anterior superior spine to neck of femur	2-2 3/4 in.
6 in. below anterior superior spine (level of lesser trochanter) to front of femur	1 1/2 in.
To great trochanter	4 1/4 in.
To lesser trochanter	3 1/2 in.
Brim of pelvis 1 in. in front of sacroiliac synchondrosis	3 3/4 in.
To anterior inferior spine	1 1/4 in.
To spine of ischium	5 in.
To ischial tuberosity	5 1/4 in.
To anterior surface of line of junction of ascending ramus of ischium and descending of pubis	2 3/4 in.
HIP AND THIGH FROM BACK	
To ischial tuberosity	2 1/4 in.
To spine of sacrum on level of posterior superior spines of ilia	1 1/4 in.
To sacral groove	2 in.
To head of femur	2 in.
To great trochanter	3-3/8 in.
To lesser trochanter	3 in.
To brim of pelvis 1 in. in front of sacroiliac synchondrosis	4 in.
To anterior inferior spine	6 in.
To spine of ischium	2 in.
To posterior surface of junction of ascending ramus of ischium and descending ramus of pubis	4 1/2 in.

Relation Between the Roentgenologist and the Surgeon. In considering the great responsibility that must be assumed by the medical profession in this serious world conflict, every effort should be made to secure that degree of fair-minded consideration of the different subdivisions that is necessary to carry on this work expeditiously and in a satisfactory manner. This is no time for the exploitation of personal prestige nor for any propaganda in reference to any department or specialty in medicine.

Considered as an end in itself no *x*-ray examination, no matter how well carried out, or accurately reported, or how much is spent in equipment, will be of any value whatever unless it gives such information to the surgeon and the physician as will expedite and facilitate their work. In saying this the writer has no intention of minimizing the importance of the *x*-ray service. Consultation with eminent surgeons who have had actual experience has indicated that roentgenology may be of the very highest importance, but it is especially desired to call the attention of both the roentgenologist and the surgeon to the fact that the full realization of the ends to be attained can only be accomplished by mutual coöperation.

If either party is destructively critical of the work of the other, if either declines to give the information in a usable form or with sufficient accuracy for practical use, or is generally incompetent, it should not be assumed by the surgeon that all roentgenologists are to be condemned, nor by the roentgenologist that all surgeons are wrong or arbitrary. Each may be expected to assist the other in a tactful and effective manner in order that they may jointly realize ways to improve the work.

When time permits, it would be extremely desirable in the Service for the surgeon to attend a considerable number of cases during the *x*-ray examination and to allow the roentgenologist to be present at the operation of these cases. In this way better realization of the specific difficulties, generally unavoidable, which beset the work of each specialist, will be mutually appreciated.

This does not mean that the surgeon should be an expert roentgenologist, or the reverse. Each has a field sufficient for all his abilities and efforts, and division of labor is essential to its rapid performance and to the highest development of the art. But both parties should be jointly responsible for a most important and valuable work in which neither can attain the full measure of success without the assistance of the other.

ADJUNCTS TO ROENTGENOTHERAPY IN THE TREATMENT OF MALIGNANT DISEASE *

BY GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PA.

THE profession now recognizes that the roentgen rays have a profound influence upon malignant disease and that, in many instances, the rays alone cause a complete and permanent disappearance of the disease. Like every other method of treatment of malignant disease, however, there are many cases in which the disease will not disappear completely or permanently when one depends upon the roentgen rays alone. Therefore, as roentgenologists, it is our duty to consider the adjuncts, or the various aids, that will help to make many more patients well.

Among these adjuncts, I would place first *electro-coagulation*. It is my custom, in nearly all instances, to destroy superficial malignant disease by electro-coagulation before applying the roentgen rays. This applies to all the epitheliomata of the skin, both the basal cell and squamous cell; all the epitheliomata of the lip and the mucous membrane of the mouth; epitheliomata of the vulva and of the penis. I am sure that I get more patients well, and better and quicker results in this group of patients than by any other means, or any other combination. After the disease is destroyed and the dead tissue curetted away, the area is treated by deep roentgenotherapy, and in mouth cases or mucous membrane cases the glandular areas in the neighborhood are thoroughly treated. This roentgen ray treatment is repeated again in four weeks, and after that as many times as seems necessary, according to the degree of malignancy, the location and the extent of the disease.

As second adjunct, I would place *surgery*, and this is placed second only because it would be second in frequency as utilized by us. In dealing with the great bulk of deep-seated tumors surgery should, of course, receive first consideration, but in every case of malignant disease such surgical intervention should be followed by roentgen ray treatment. To be more specific, I believe that all carcinomas of the breast should be removed surgically if they are in an operable condition and the patient will give consent. Based upon the theory that the roentgen ray decreases the malignancy of the cells and decreases their power of reproduction, as shown by experimental evidence, I have, in a few instances, given a course of treatment covering the mammary glands and the glandular areas round about, and then immediately requested the removal of the tumor, and a complete surgical operation. Time is too short to draw any conclusions with regard to this procedure, but I can say definitely that there have been no unfavorable results. That is, the wounds have healed properly, and without any interference, and in the patients who have been thus treated there have been no recurrences up to date. *Metastatic* glands I believe should always be resected surgically, when it can be done, instead of depending upon the roentgen ray to control their growth. We have all seen enlarged glands disappear under roentgen ray treatment, but we are particularly liable to disappointment in the group of cases in which there had been metastasis from an epithelioma within the mouth, and in these cases I am most thankful for the assistance of a surgeon.

Radium. Radium can be used in conjunction with the roentgen ray, but it should never be applied through the same area of skin or mucous membrane. It can be utilized, however, to great advantage in the treatment of all malignant disease involving cavities. The radium can be introduced within the cavity and the roent-

* Presented in the form of a lantern slide demonstration before the Midwinter Meeting of Roentgenologists at Hotel Traymore, Atlantic City, January 4 and 5, 1918.

gen ray can be used for cross-firing purposes from the outside without any interference. In this way the radium simply furnishes another source of cross-firing and, in many

FIG. 1. EPITHELIOMA INVOLVING TWO-THIRDS OF THE LOWER LIP. SHOWING THE RESULT OF COMBINING EXCISION WITH ROENTGEN RAY TREATMENT.

instances, the radium can be brought in much closer contact with the disease than can the roentgen ray through the outside of the body. I have in mind particularly the carcinomas of the uterus, vagina, rectum, the mouth, nasal cavity and esophagus.

Brief histories of a few cases will best illustrate the types which will not ordinarily yield to the roentgen ray alone, but which will yield and will get well from combined methods of treatment.

CASE 1.—(Fig. 1.) Mr. G. R. Referred by another patient April 25, 1903. Had an epithelioma involving at least two-thirds of the lower lip. It followed a fever blister which developed two years previously. He had had an attempt at removal by a plaster applied by a cancer quack without success. At the time of beginning treatment it was an ugly, ulcerating, vegetating growth of the lower lip. He was given fractional doses of roentgen ray treatment, without filtration, applied three times a week during a period of three months, in 1903. He had, associated with the epithelioma, enlarged submental and submaxillary glands. At the end of three months, at my request, Dr. Laplace excised two-thirds of the lower lip, and the day following I continued roentgen ray treatment. The wound healed without any interruption. The submaxillary and submental glands disappeared and the patient has remained well to date, which is approximately fifteen years. *Remarks:*—I believe that if I had depended upon the roentgen ray alone, especially in that day, that I would have so devitalized the surrounding tissues before I got rid of the malignant disease that I would not have gotten him permanently well.

CASE 2.—(Fig. 2.) Mr. J. H. Age 67. Referred by Dr. Jos. Gibbs June 24, 1913. Epithelioma had been developing four months and involved the entire lower lip. This seemed to me to be clearly a case that would not get well by roentgen ray treatment alone. Therefore, I destroyed the entire lower lip by electro-coagulation, for the entire lower lip was involved. There were no palpable submaxillary glands. The wound healed without interruption, and no metastasis developed at any time. Roentgen ray treatment had been given

FIG. 2. EPITHELIOMA INVOLVING THE ENTIRE LOWER LIP. SHOWING THE RESULT OF COMBINING ELECTROCOAGULATION WITH ROENTGEN RAY TREATMENT.

over the lip and under the jaw until March 30, 1914, at which time he seemed to be perfectly well, and he had no signs of recurrence at any time nor of metastasis. He

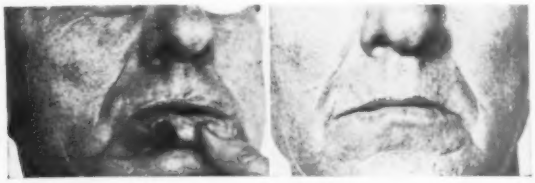

FIG. 3. SMALL EPITHELIOMA OF THE LIP. SHOWING THE END RESULT AFTER ELECTRO-COAGULATION AND ROENTGEN RAY TREATMENT.

died of apoplexy October 1915. *Remarks*:—I have every reason to believe that this patient would have remained well indefinitely. He, of course, sacrificed his lower lip, but this was replaced in part by an artificial lip, and a beard which were attached by a dentist to a plate in his mouth. It enabled him to eat his food and to carry on conversation so that the average person was unaware of his troubles.

CASE 3.—(Fig. 3.) Mr. A. F. Age 61. Referred by Dr. J. E. Bauman February 27, 1915. Epithelioma of the lip about 5/8" in diameter involving both the cutaneous and the buccal portion of the mucous membrane. Destroyed by electro-coagulation at once and the lip area and submental region treated by the roentgen rays March 5, April 9, and May 28, 1915. He is well today. *Remarks:*—In this case the roentgen rays alone would have probably given a fifty-fifty chance of recovery, but it would have required considerably more treatment, and I believe less positive results would have been obtained. In using the combined treatment of electro-coagulation and roentgen ray, I count on getting all of these patients well. I have not failed in any epithelioma of the lip that had not been previously treated by caustics or an incomplete operation, and in no case have I had metastasis to deal with. I saw this patient four times in all.

CASE 4.—(Fig. 4.) Mr. W. S. M. Age 49. Referred by Dr. W. J. Dubler. An excessive smoker. Had an epithelioma involving the central third of the lower lip, and extending well inside the mouth, apparently extending about one-half inch in depth. Wassermann test negative. The whole area was destroyed by electro-coagulation, followed by three courses of roentgen ray treatment, and there has been no recurrence to date. He continued excessive smoking, and on October 12, 1917, he developed a small new lesion entirely separated from the previous area of involvement, and I believe having no connection with it. This was promptly destroyed with excellent results. *Remarks:*—This is the type of case in which one would expect a local excision and extensive dissection of the tissues of the neck in order to obtain a cure. The above procedure seems to give more satisfactory results with less traumatism.

CASE 5.—(Fig. 5.) Mr. S. S. Age 46. Referred by Dr. Ernest Laplace, May 26, 1916. He had an epithelioma of the penis lasting for a year, and involving the glans and about an inch of the corpora cavernosum. It was of the squamous-cell type. The entire glans and about an inch of the

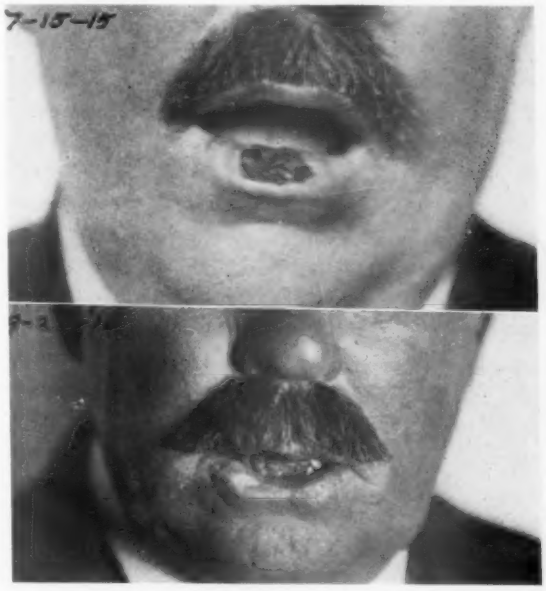

FIG. 4. EPITHELIOMA INVOLVING THE MIDDLE HALF OF THE LOWER LIP. SHOWING THE RESULTS OF COMBINING ELECTRO-COAGULATION AND ROENTGEN RAY TREATMENT.

corpora were destroyed by electro-coagulation, with a portion of the prepuce. He was then given deep roentgenotherapy through ten portals of entry, covering the penis and glandular area leading therefrom, and this course of roentgen ray treatment was repeated again July 3, August 3, October 11, November 21, and December 31, 1916.

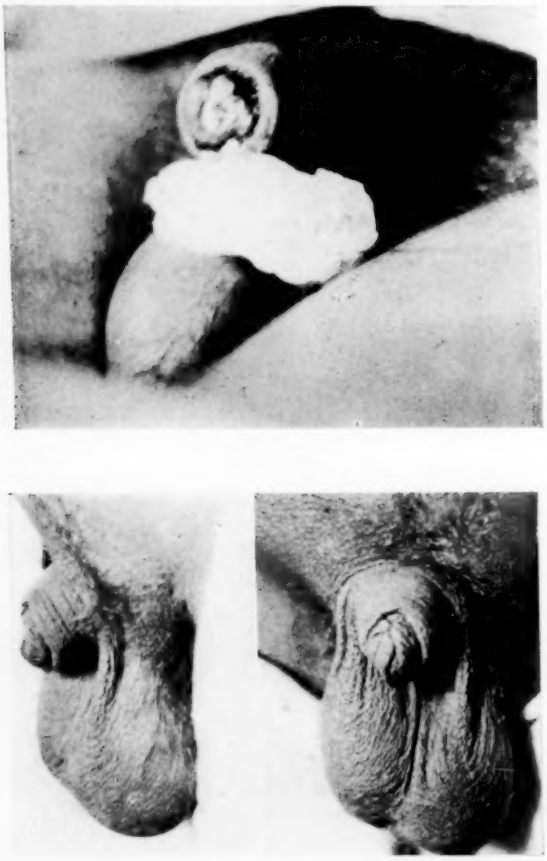

FIG. 5. EPITHELIOMA OF THE PENIS. SHOWING THE RESULTS OF COMBINING ELECTRO-COAGULATION AND ROENTGEN RAY TREATMENT.

Since then he has had no treatment, but has remained well and is working daily. There has been no interference with the urinary functions, and in general appearance, when nude, the effects of the operation would not be noticeable. *Remarks:*—There were, at the time of beginning treatment, some very small palpable glands in the left groin. These were not sufficient to be considered metastatic, and yet could not be definitely ruled out. However, they disappeared under roentgen ray treatment. When one considers the frequency with which recurrence and metastasis develops from epithelioma of the penis following surgical removal, one cannot help but feel that this is an advance in the treatment of malignant disease in this region, and it was this thought which prompted Dr. Laplace to refer the patient to me.

CASE 6.—(Fig. 6.) Mrs. K. L. Age 68. Referred to me by Dr. Wm. L. Rodman, April 3, 1914, with a large, adherent, scirrhous carcinoma of the right breast. It had been growing five years; had been treated by a plaster without success. It was firmly adherent to the chest wall, and involved the intercostal muscles. For this reason Dr. Rodman considered it inoperable. We could detect no glandular enlargement in the axilla or supraclavicular region. A roentgenogram of the chest showed a shadow of the tumor and in addition a number of small, dense glands along the mediastinum. On account of the absence of palpable glandular involvement, and with the possibility of the mediastinal glands not being malignant, I considered the combined treatment by electro-coagulation and deep roentgenotherapy as applicable. I destroyed the tumor by electrothermic-coagulation, cooking from the surface downward, and then shaving off the cooked malignant tissue until I reached the intercostal muscles. I had to work very carefully in this way for fear of penetrating the chest wall and lung. This destruction was preceded and followed by deep roentgenotherapy over a period of three months, the treatment being directed over the wound and toward the mediastinum, one course of treatment being given each month. She returned to her home the latter part of June 1914, and has had no treatment since. The wound healed by granulation. She remained well for two years, and then died of apoplexy. *Remarks:*—I believe that the breast cases are rare that will be suitable for this method of treat-

ment, but in just this type I believe that the method of treatment outlined offers more hope of permanent recovery than does surgical removal, even if followed by roentgen ray treatment.

CASE 7.—(Fig. 7.) Mr. H. S. Age 54. Referred by Dr. J. R. Umstad, October 31, 1913. He had had an epithelioma on his left forehead for eight years. It had been treated by roentgen rays, by caustics, by curettement, by violet rays, and by carbon dioxide snow, but never got well, and was always followed by a recurrence. At the time of reporting for treatment, the epithelioma was about 2½″ in diameter and extended down to and involved the outer table of the skull. The whole area was destroyed by electro-coagulation. The patient was told at once that he would require a secondary operation for the removal of at least the outer table of the skull. Following the electro-coagulation the patient received roentgen ray treatment until the wound was healthy in appearance. On March 31, 1914, Dr. Warmuth resected the dead bone, and then did a plastic operation covering the area with a flap of skin removed from the opposite side of the forehead. Both areas healed thoroughly and he has remained well to date, which is more than four years. *Remarks:*—I have never seen an epithelioma yield to roentgen ray treatment when the surface of the bone was eroded or involved by the extension. Therefore, some additional method of treatment must be applied. Likewise one will do well if they warn the patient in advance that surgical assistance will also be necessary. In this case all the various single methods of treatment of epithelioma had been applied without success. At the present time the opening in the skull seems to be filling in with bone. At least, it is quite solid.

CASE 8.—(Fig. 8.) Mr. W. E. R. Age 40. Referred by Dr. Ernest Laplace, June 10, 1915. Considered by Dr. Laplace inoperable and hopeless. He had an epithelioma involving the whole inside of the cheek, the superior maxilla, the inferior maxilla, with a mass of metastatic glands under the jaw. I destroyed the disease inside of the mouth by electro-coagulation. Dr. Laplace, at the same time, excised the metastatic glands

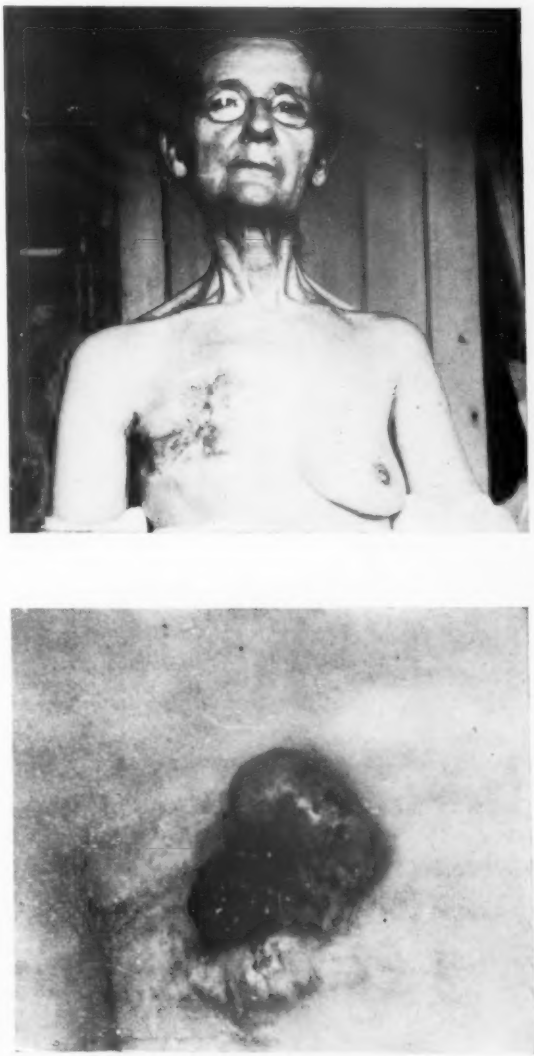

FIG. 6. INOPERABLE CARCINOMA OF THE BREAST. DESTROYED BY ELECTRO-COAGULATION, FOLLOWED BY DEEP ROENTGENOTHERAPY, AND ALLOWED TO HEAL BY GRANULATION.

and resected half of the lower jaw, which was found to have been almost totally diseased. This was followed by applications of radium inside the mouth, especially in the region of the upper jaw and on the inside of the wound, and he received

roentgen ray treatment externally until December 16, 1915, since which time he has had no treatment. In June, 1916, Dr. Laplace closed the opening in his cheek working every day since. *Remarks:*—When one considers the extent of this disease it seems that the man is fortunate in recovering, and I believe his recovery is due to

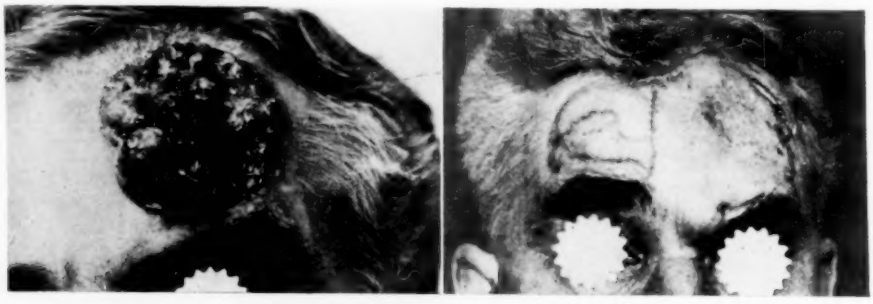

FIG. 7. EPITHELIOMA OF THE FRONTAL REGION. IT HAD BEEN TREATED UNSUCCESSFULLY BY MANY METHODS, INVOLVING THE OUTER TABLE OF THE SKULL. DESTROYED BY ELECTRO-COAGULATION, TREATED BY DEEP ROENTGENOTHERAPY AND FOLLOWED BY A PLASTIC OPERATION.

which had been made by the electro-coagulation, and he has remained well, and is the fact that no single method of treatment was depended upon, but that the roentgen ray, radium, surgery and electro-coagulation were all combined and used conjointly to eliminate the disease.

FIG. 8. CARCINOMA INVOLVING THE CHEEK, SUPERIOR AND INFERIOR MAXILLA, AND A MASS OF SUBMAXILLARY GLANDS. DESTROYED BY ELECTRO-COAGULATION.

Left half of the lower jaw resected by Dr. Laplace, together with the metastatic glands; followed by deep roentgenotherapy and radium.

CASE 9.—(Fig. 9.) Mrs. A. M. D. Age 65. Referred by Drs. J. E. Freeman and M. B. Hartzel. Twenty-eight years previously the patient first developed an epithelioma on the right cheek in front of the ear. It continued for three or four years without receiving any attention. Seventeen years ago she had a plaster applied without success. Seven years ago she was treated by roentgen rays in one of the hospital dispensaries. This treatment was continued for four years. At the end of this time, the disease had disappeared and was replaced by scar tissue. When she reported for treatment she had an indurated malignant ulcer in the center of the scar tissue 1″ x 1½″, and about ¼″ in depth. There was no doubt in the minds of any of us as to the malignancy of this lesion, and that it was a secondary malignant degeneration in the scar tissue resulting from former roentgen ray treatment. There was also associated the general firmness, scaliness and telangiectasis that is seen in this type of case. The diseased area on the right side of the

cheek was destroyed by electro-coagulation together with three small epitheliomata on the left cheek. She was then given a full dose of roentgen ray treatment over each area. The diseased area healed and she has remained well to date. *Remarks:*—This case represents another type in which one cannot expect a cure from roentgen ray treatment, but the violent reaction that follows the electro-coagulation seems to improve the local blood supply in some way and brings about a healing process with general improvement of the local and surrounding tissue.

FIG. 9. EPITHELIOMA DEVELOPING IN A DEGENERATING ROENTGEN RAY SCAR. DESTROYED BY ELECTRO-COAGULATION; FOLLOWED BY HEALING.

CASE 10.—(Fig. 10.) Miss E. H. Age 65. Referred by Dr. J. B. Cassidy, February 5, 1917. For five years the patient had been treated by roentgen rays at intervals and evidently with small doses. When she reported to me for treatment she had a great deal of scar tissue about the angle of the jaw, under the ear, an ulcerating epithelioma about two inches in diameter, with an induration, apparently malignant, extending about two inches further upward into the scalp. The whole area was destroyed by electro-coagulation together with about twenty-five small keratoses on the face. The large ulcer was then treated by roentgen rays February 13, March 19, April 14, and May 21, at which time the wound was healed by granulations and the scar tissue appeared to be healthy. It has remained healthy to the present time. *Remarks:*—This patient is another type that would not yield to roentgen ray treatment. There had been so much roentgen ray treatment given in small doses and scattered over such a long period of time that the cells had, in part, developed a resistance to the rays and were probably

FIG. 10. EPITHELIOMA IN FRONT OF THE EAR PARTIALLY HEALED BY LONG ROENTGEN RAY TREATMENT, THEN TAKING ON ACTIVE GROWTH. DESTROYED BY ELECTRO-COAGULATION, FOLLOWED BY DEEP ROENTGENOTHERAPY. HEALED.

protected more or less by scar tissue. In addition to this the scar tissue, and even the other tissue round about the lesion, had lost its power of repair. In addition to this I have found that when these epitheliomata extend up into the subcutaneous tissues of the scalp they do not respond readily to roentgen ray treatment, but by combining treatment in this way success has been made of what would otherwise have been a failure.

CASE 11.—(Fig. 11.) Mr. H. L. Age 64. Referred by Dr. M. B. Hartzel, October 9, 1916. The patient had been treated by roentgen rays for four years for epithelioma of the nose. For a time the disease seemed to have nearly disappeared, but continually recurred and finally the roentgen ray treatment seemed to have no effect upon it. When I first saw him he had lost most of the right ala, but the disease extended deep into the lateral wall of the right nostril and extended up into the bridge so that the cartilage was involved and the surrounding tissue had a dense and firm appearance. I destroyed the entire diseased area, together with about an inch of the outer wall of the right nostril. He then received roentgen ray treatment at intervals of a month during three months. Three weeks ago Dr. Laplace, at my request, did a plastic operation to close up the right nostril. The end result has been perfect. *Remarks:*—This patient would not have recovered from roentgen ray treatment alone, first because the tissues had lost the power of responding to roentgen ray treatment, and second because the cartilage of the nose had become involved. It is my experience that when the cartilage of the nose has become involved it will not get well from roentgen ray treatment alone, though it may improve many times.

FIG. 11. EPITHELIOMA OF THE NOSE, HAVING DESTROYED THE CARTILAGE AND EXTENDING INTO THE DEEPER TISSUES. TREATED FOR FOUR YEARS BY FRACTIONAL DOSES OF ROENTGEN RAYS, TAKING ON NEW ACTIVITY. DESTROYED BY ELECTRO-COAGULATION, FOLLOWED BY DEEP ROENTGENOTHERAPY. HEALED.

CASE 12.—(Fig. 12.) Mrs. A. Age 54. Referred by Dr. Stillwell Burns August 11, 1913. This patient received a severe burn of the left hand, in 1882. This healed with a tightly drawn cicatrix which continually cracked open and finally an extensive epithelioma developed about 2½" in diameter. The diseased area was destroyed by electro-coagulation, and then a course of roentgen ray treatment was given over the hand, over the arm, and in the axilla through six portals of entry. October 27, 1913, the slough had separated and there was an area of healthy granulations. In February, 1914, Dr. Burns very kindly did a skin grafting operation to close over the open surface. The patient has remained entirely well and reports herself in excellent condition, November 20, 1917. *Remarks:*—It is my observation that epitheliomata developing on the basis of scar tissue do not yield well to roentgen ray treatment. There seems to be a lack of reparative power, and in the process of repair the cells find a basis for recurrence. I believe, therefore, that in such cases the disease should either be thoroughly destroyed by electro-coagulation, as was done in this case, or should be excised surgically. It is the type of case in which

we should not depend upon the roentgen ray alone.

FIG. 12. EPITHELIOMA DEVELOPING IN THE SCAR OF AN OLD BURN. DESTROYED BY ELECTRO-COAGULATION, FOLLOWED BY SKIN GRAFT BY DR. BURNS.

CASE 13.—(Fig. 13.) Mr. M. E. Age 48. Referred to me by Dr. John B. Deaver, April 10, 1917. In September 20, 1916, Dr. Deaver did an operation for the removal of an epithelioma of the lower lip with metastasis in the right submaxillary region. At the time that the patient came to me for treatment he had a tumor mass attached to and developing from the right lower jaw which was shown by roentgen ray examination to be metastatic disease, and involved the lower jaw bone. We first gave him a thorough course of roentgen ray treatment through eight portals of entry, cross-firing upon the disease, finishing on April 12. On April 16, two days later, at my request, Dr. Stillwell Burns resected the right half of the lower jaw, closing the wound immediately. The patient then received another course of treatment in May through nine portals of entry, and similarly in June, July, August, September and October. He is now working every day, has no signs of malignant disease, and, strange to

FIG. 13. RECURRENT METASTATIC DISEASE OF THE JAW BONE, SHOWING ROENTGENOGRAM OF THE DISEASED AREA AND THE PHOTOGRAPHS SHOWING THE PROJECTION FROM THE JAW BONE BY THE TUMOR MASS AND THE RESULT AFTER RESECTION AND ROENTGEN RAY TREATMENT.

say, he is able to chew his food and live a normal life. A casual observer would now not notice any evidences of the diseased jaw in his face, so well was the operation

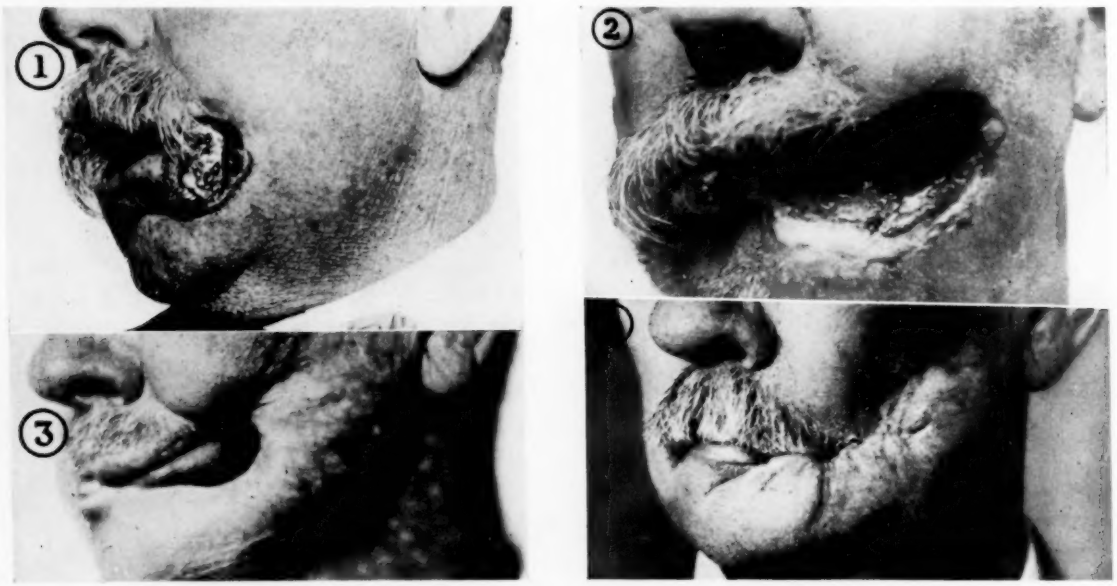

FIG. 14. EPITHELIOMA OF THE LIPS, ANGLE OF THE MOUTH AND INSIDE OF THE CHEEK, SHOWING (1) EXTERNAL LESION; (2) THE RESULT AFTER ELECTRO-COAGULATION; (3) AFTER HEALING PROCESS; (4) AFTER PLASTIC OPERATION.

done, and so perfectly have the tissues adjusted themselves. *Remarks:*—This case was considered by Dr. Deaver as inoperable in the sense of getting the patient permanently well. He would not have gotten well from roentgen ray treatment alone, but by carefully combining surgery and roentgen ray treatment I believe that this man will get permanently well. The period of time since the work has been done is too short to make any such claim as yet.

CASE 14.—(Fig. 14.) Mr. J. P. Age 58. Referred by H. W. Dachtler of Toledo, Ohio, January 20, 1913. He had had an epithelioma at the angle of the mouth for twelve years. In October, 1911, consulted Mr. Dachtler and was treated by the roentgen rays under which he got nearly well, but during Mr. Dachtler's absence from the city the disease redeveloped and would then not respond to the roentgen ray treatment. When he came to me for treatment he had an ulcerating epithelioma about an inch in diameter at the left angle of the mouth, with extension of the disease so as to involve two-thirds of the lower lip and one-third of the upper lip, continuing backward inside the cheek to the angle of the jaw. The whole area of disease, together with the whole left side of the cheek, was excised by electro-coagulation. He was then treated by radium at the angle of the jaw inside, which seemed to be the most obstinate in responding, and was treated by the roentgen rays externally until all the tissue had a healthy appearance. About a year later (April 1914) Dr. Laplace did a plastic operation, suturing the open wound and closing his mouth. He has remained well to the present time—almost five years since the treatment was begun. *Remarks:*—This case likewise represents a type that will not get well from roentgen ray treatment. When a patient under roentgen ray treatment reaches a point at which the disease remains stationary for a time and then takes on more active growth, further roentgen ray treat-

ment generally fails and some other more active method of treatment must be instituted. When it is possible to use it, I believe that electro-coagulation will be the most efficient. The roentgen ray treatment can then be used again with benefit, as in this case. Here is another instance in which four methods of treatment were used to bring about a cure.

FIG. 15. EPITHELIOMA ON THE INSIDE OF THE CHEEK ASSOCIATED WITH METASTATIC DISEASE IN THE SUBMAXILLARY REGION. TREATED BY ELECTRO-COAGULATION, SURGICAL RESECTION OF THE METASTATIC GLANDS AND ROENTGEN RAY TREATMENT.

CASE 15.—(Fig. 15.) Mr. J. M. L. Age 59. Dr. Laplace and the writer examined this patient December 14, 1914. For a year the patient had had an epithelioma growing on the inside of his left cheek, and at the time that he was seen by us the epithelioma was about 1½" in diameter, involved most of the depth of the tissues of the cheek, together with a mass of glands in the submaxillary region. After a conference we decided to destroy the disease inside the mouth by electro-coagulation and to resect the metastatic glands surgically, and then follow this by active roentgen ray treatment. After these operations the patient was given a course of treatment during December, 1914, and during January, February, March and April. Since then he has had no treatment, but was still well at his last report November 19, 1917—approximately three years. *Remarks:*—As a result of the methods of treatment used in this case we saved the man's cheek, eliminated deformity of the mouth, and by combining electro-coagulation, surgery and roentgen ray, have obtained a permanent result of which we can be proud.

CASE 16.—Mr. D. G. Age 48. Referred by Dr. Paul Traub, February 20, 1915. The patient had an epithelioma developing in the right side of the mouth involving the alveolar process, the side of the tongue and the floor of the mouth, during a period of at least four months. The whole area was destroyed by electro-coagulation. In the destruction the inferior dental artery was reached, which resulted in a large sequestrum of the lower jaw first being thrown off and later necrosis and separation of the posterior two-thirds of the lower jaw, but with ultimate healing and healthy

tissue. Up to the present time the patient has not reported for a plastic operation as requested, but has remained free from malignant disease. *Remarks:*—This again is a type of disease that will not respond to roentgen ray treatment alone nor to radium treatment alone. But by local destruction, followed by roentgen ray treatment, one can with due care eliminate the malignant disease. A surgeon will then have to be called upon to close the mouth. I believe that when the lower jaw is involved it is wise to resect half of the lower jaw, because if one resects the central portion of one side or destroys it the remainder of the bone does not seem to receive sufficient blood supply for nutrition, and a gradual necrotic process takes place which is most annoying; whereas if one does a complete resection the patient still has half of the lower jaw to chew with and the end results are, to my mind, more satisfactory.

CONCLUSIONS

1. The above cases have been selected with the idea of illustrating the type of case that will not respond to roentgen ray treatment alone, but which can be made well if the roentgen ray treatment is combined with one or more other well-recognized methods of treatment of malignant disease, which, for convenience, we will call *adjuncts*.

2. In many of these cases I am sure that nothing short of the combinations used would have made the patient well.

3. I make a plea for an early survey of the whole case and a careful choice of treatment before beginning, for this will save much suffering, much time, and much waste of energy.

DIFFERENTIAL DIAGNOSIS OF BONE TUMORS

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IN the diagnosis of bone tumors the essential thing is to determine whether the growth is malignant or benign. If that point can be determined the surgeon will be given the information that he wishes. It is well, however, to go beyond that and, if possible, determine the character of the growth belonging to these two great classes.

We have found the following set of cardinal points of great assistance in establishing the correct diagnosis. They are: *first*, invasion; *second*, bone production; *third*, point of origin; *fourth*, condition of the cortex. Of course it is not always possible to establish the presence of these four points, but practically with every tumor that we see we will be able to find one of these groups in which to place it. By so doing we can automatically rule out a number of growths. The establishment of one such point will almost inevitably give a clue to one or more other points and thus eventually establish the diagnosis.

Taking up the first cardinal point, *invasion:* if invasion or non-invasion can be established one can immediately place the tumor in either the malignant or benign group. This first point, however, is frequently the hardest to establish.

If the first point can be established the second group, *bone production*, should be decided upon. The establishment of this point immediately begins to limit the number of growths we have to take into consideration. It automatically rules out some of the malignant and some of the benign varieties.

The third point, *origin*, helps in establishing whether the group is medullary or cortical in origin.

The fourth point, *cortex*, helps very materially as it tells whether the cortex is present or absent, whether it is intact or not, whether it is swollen or not.

Malignant Growths.—The characteristics of malignant growths are the following: They generally start at some central point and grow equally in all directions. They are never definitely limited, and when medullary in origin the bone is never expanded as the growth is so rapid that it sweeps through and destroys the cortex before it can expand. The growth extends through the cortex as quickly as it extends down the medullary canal. It is not limited in any place in the medullary canal; it is so invasive that it is frequently very difficult to determine where the growth stops and where the normal medullary tissue begins. The non-malignant growths, as a rule, when arising in the medullary canal, have a tendency to extend up and down the medulla, the cortex being bulged in a cylindrical manner, not destroyed, and the growth terminating very abruptly, so that there is a definite line of demarcation.

The malignant growths most commonly seen are carcinoma and the subdivisions of sarcomata—namely, the round-cell, the spindle-cell, the periosteal and osteosarcoma. Giant-cell sarcoma is not included in this group on account of its benign nature. We have included it among the non-malignant growths. Carcinoma, round- and spindle-cell sarcomata are practically always medullary in origin. These are very rapidly growing tumors and extend equally in all directions. The cortex is never swollen but is eaten through and disappears. There is no new formation of bone, either within the growth or at its edges. New bone formation is only seen at the edge of the growth in extremely slow growing tumors. Such tumors grow so slowly that nature has a chance to establish a calcium wall before the growth has spread beyond that point. It is impossible, from an *x*-ray standpoint, to differentiate between the pure sarcomata and carcinomata, as the *x*-ray findings are identical. The only aid in helping to differentiate these conditions is the fact that the carcinoma, being metastatic in origin, is usually situated near the entrance of the nutrient artery, while the sarcoma, being either primary or metastatic in the bone, may occur anywhere within the shaft of the bone.

Periosteal sarcoma, as its name implies, is a bone producer. It arises from the periosteum and we may have extensive involvement of the soft tissues with very little of the bone being involved. It is probably the most characteristic of all our tumor growths, since in a typical growth we have small lines of calcium salts laid down perpendicular to the shaft but not quite reaching the cortex, resembling roughly sun rays. This deposit of calcium salts is within the growth and is outside of the bone proper—in other words, apparently in the soft tissue.

Osteosarcoma is also a bone producer, the amount of bone produced depending entirely upon the malignancy of the individual tumor. In the very malignant type of osteosarcoma we find but very little bone production. The growth arises both from the cortex and the medullary portion of the bone and produces bone as well as extensive destruction of the shaft. There is also new bone production out in the growth in the soft tissue and this bone is laid down in a somewhat similar manner to the periosteal sarcoma. The difference between it and the periosteal sarcoma is that with osteosarcoma we have more or less extensive destruction of the shaft and generally more bone production in the tissue outside of the bone, while periosteal sarcoma does not produce many changes in the shaft until a very advanced stage of the growth is reached. Of all the malignant tumors the above two tumors are the only ones that produce bone within the growths themselves.

There is one other malignant growth in which there is bone production, but this is not within the growth but in the normal bone surrounding the growth, namely,

prostatic carcinoma. In this we find destruction of bone just as in the other malignant growths, but in the normal bone surrounding it we find eburnation and more or less density of bone, this being due to the fact that the growth is of such slow-growing nature that the normal bone around it is stimulated and sufficient time is given for the production of new bone. This new bone is confined entirely within the bone itself and does not take place in the soft tissue.

Benign Growths.—The characteristics of the most common of the benign growths are as follows: Osteoma arises from the region of the cortex and extends well out into the soft tissue. It generally assumes a cauliflower shape and is characterized by a large amount of new bone laid down in a symmetrical manner with a very definite border and no evidence of any invasion. It is frequently multiple at the seat of origin and may take on an appearance of a huge exostosis. It may spring from any portion of the bone but is most commonly seen near the end of the bone.

Osteochondroma is composed of both cartilage and bone and is generally medullary in origin, although occasionally but rarely arising from the cortex. When occurring within the medullary portion of the bone the growth has a tendency to extend up and down the shaft; the shaft is swollen, acquiring a cylindrical appearance. The growth may be loculated. The cortex is practically always intact unless fractured by some trauma. The growth is definitely limited, having a sharpened border. When the growth is situated at the end of the bone one will find that the cortex is very much distended but intact. It is very irregular in outline, the normal bony tissue being completely gone and being replaced by bone and cartilage. The amount of bone present varies according to whether much or little cartilage is in the tumor. There is never any new bone production unless there is trauma. There is some eburnation of the bone at the edge of the growth.

Bone cysts are always benign, practically always occur within the shaft of the bone and present appearances somewhat similar to enchondromata. They are generally situated near the epiphyseal line; they cause a cylindrical bulging of the shaft; they have a very definite border; they are sometimes loculated; and, as a rule, they do not expand the shaft as much or as irregularly as enchondromata.

Giant-cell sarcoma, while belonging to the malignant family on account of the type cell forming the growth, is benign in character and very slow in growth. It generally occurs near the end of the bone. Like a malignant growth, it grows equally in all directions, but instead of sweeping away the cortex the latter is bulged and expands so that, unless the growth is very large, the cortex will be found intact, thinned out to a mere line, but still sufficiently dense to be easily traced throughout its entire length. The growth stops abruptly, and at its base, in the medulla, there is generally a calcium wall. It is practically the only one of the benign growths that extends symmetrically in all directions.

Fibromata are generally benign and have a cystic appearance, regarding formation in the bone.

There is one other benign condition which is frequently mistaken for a malignant growth, namely, an ossifying hematoma. This condition arises from some trauma to the bone in the adult or scurvy in growing children, where the periosteum has been elevated and a hemorrhage has occurred beneath. This condition cannot be demonstrated until sufficient time has elapsed for formation of new bone, and then production of new bone out in the soft tissue adjacent to the shaft results. It is very hard and dense and is frequently mistaken for sarcoma. There is, however, a definite bony border due to the deposit of calcium salts in the periosteum, and the bone is laid down more or less parallel to the shaft of the bone. This is an important point, because the malignant bone-pro-

ducing growths lay down their bone generally perpendicular to the shaft.

Myositis ossificans is readily distinguished by bone being laid down in the muscle. As a rule it is not connected with the shaft and it follows the striæ of the muscles so that a mistake is not apt to be made.

APPLICATION OF CARDINAL POINTS

The practical working of these cardinal points may be illustrated as follows: Suppose, for example, we take a carcinoma. It is just possible that we might not be able to determine offhand whether there is invasion or not. We should then consider the second cardinal point, bone production. It will be found that there is no bone production, since carcinoma, being of epithelial origin, cannot produce bone. This would immediately rule out two malignant growths, periosteal sarcomata and osteosarcomata. In the benign group it would rule out osteoma and ossifying hematoma. In the malignant group sarcoma and carcinoma would still have to be considered; in the benign group, enchondroma, bone cysts and fibroma. We now proceed to the third cardinal point, namely, origin. Since we know it is carcinoma we know that it is medullary in origin. The other conditions mentioned are also medullary in origin. The fourth cardinal point, the condition of cortex, would then come under consideration. Since this is carcinoma we must find that the cortex is not expanded, but has been completely swept away. This would immediately rule out all the benign growths since they all have a definite cortex. Consequently, we would be forced to conclude that the growth is either sarcoma or carcinoma.

Now, as a second example, let us take one of the bone-producing growths, periosteal sarcoma. Again let us assume that we can not establish invasion. Since in periosteal sarcoma there is bone production we would take up the second cardinal point. Of the bone-producing tumors that are malignant there are only two, namely, periosteal sarcoma and osteosarcoma. Of the benign bone-producing tumors we would include osteoma and the ossifying hematoma. We would now proceed to the third condition, the point of origin. Arising from the cortex this growth could still be any of the above-mentioned conditions. In the fourth cardinal point, condition of the cortex, we should find that the cortex is slightly invaded, that the bone is laid down in the soft tissue and that the deposit is perpendicular in character.

There are only two conditions in which the bone is laid down perpendicular to the shaft and these are osteosarcoma and periosteal sarcoma. In osteoma the bone is laid down from a central point, presenting a cauliflower appearance; in ossifying hematoma the bone is laid down parallel to the shaft; and in both of these conditions, that is, osteoma and ossifying hematoma, there is a definite border. Consequently, in this example the bone is perpendicular to the shaft, there is no definite border, and the fact that the shaft is not involved indicates that we are dealing with a periosteal sarcoma.

In all the bone-producing tumors osteomyelitis must be taken into consideration, but we must remember that osteomyelitis when it comes within the shaft does not destroy as a solid mass but tends to destroy in spots, leaving dead pieces of bone in the shaft; also that it breaks through the cortex, probably in one or two places, leaving the rest of the cortex present. The shaft is not expanded but the periosteum, being thickened, frequently gives the appearance of a swollen shaft which in reality is due to the deposit of bone in the periosteum and not to actual expansion of the shaft. Then, too, in osteomyelitis we never see new bone in the soft tissue which is not connected with the periosteum. We may see an occasional piece of bone but it is generally a single piece, which means that it is a sequestrum being discharged through a sinus.

In conclusion, we must remember that these growths and metastases in the flat

bones, such as the cranial bones or the scapulæ, do not present the same typical appearances as in long bones and, consequently, these cardinal points are not applicable. Also, the character of the growth is very materially changed after there has been any surgical interference. A third exception is that in multiple metastatic carcinoma we usually lose all sign of invasion, the growth being definitely limited and frequently the cortex being expanded without destruction.

Excluding the above exceptions, we will find that most of the bone tumors can be diagnosed by the cardinal points above mentioned. Even when the growth is atypical in appearance, by means of one of these four points it is possible to identify it.

USE OF RADIUM IN NON-MALIGNANT UTERINE HEMORRHAGE

Drs. C. Jeff Miller and E. L. King, New Orleans: The non-malignant conditions of the uterus causing menorrhagia or metrorrhagia may be thus grouped: 1. Cases in which there is little or no demonstrable pathologic change in the uterine wall, no history of infection, and in which the uterus is apparently normal in size and position, with normal adnexa. In such cases, the bleeding is, in all probability, due to some disturbance of the internal secretions, especially of the thyroid or of the ovary. This condition is often encountered in young girls about puberty. 2. The menopause. 3. Chronic metritis. 4. Hypertrophy or hyperplasia of the endometrium, especially when so marked as to be adenomatous or polypoid in character. 5. Fibroids, adenomas or adenomyomas of the uterus. 6. Chronic endometritis, especially after incomplete abortion. 7. Passive congestion of the uterus, as in retroflexion or prolapse. In the first three groups, radium may be used to the exclusion of surgery; in the fourth and fifth, some cases are suitable for radium and others require operation; while in the sixth and seventh groups, operation is indicated.

We have treated ten cases classified under the first two groups. In all of them the bleeding had persisted for years and had resisted every form of treatment. Nine of the patients were given intra-uterine radium treatments, the average dose being about 1,000 milligram-hours. In only one patient did the treatment fail to relieve the condition. Only one patient suffered from severe menopausal symptoms, although in several of them the symptoms were present in a mild degree.

Eighteen cases fall in the third and fourth groups. The patients ranged in age from 30 to 55, and most of them had suffered from bleeding for several years—as a rule, menorrhagia first, and later metrorrhagia as well. In every case, radium treatment was followed by amenorrhea; in two patients there was a recurrence of the bleeding about one year later, the flow being approximately normal. The others are still relieved. Six patients suffered from marked menopausal symptoms; five others were similarly affected, but the symptoms were mild and transient. The patients suffering most from the artificial menopause were nearly all between 40 and 51; this coincides with our experience after hysterectomy. In three women, aged 35, 45 and 51, the condition was relieved by corpus luteum extract. Eight patients suffered from leukorrhea for two or three months after the treatment. In those cases in which subsequent pelvic examinations were made, marked reduction in the size of the uterus was found, and the tenderness, as a rule, disappeared. The dosage in these cases was from 500 to 1,000 milligram-hours. (*Discussion, Annual Meeting South. Med. Assn.*, Memphis, Tenn., Nov. 12–15, 1917.) (Ref. *Jour. Am. M. Assn.*, Dec. 15, 1917, p. 2066.)

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ROENTGEN PLEURITIS

In the February 1918 issue of the JOURNAL, Dr. Lloyd Bryan made a report on "Roentgen Pleuritis." In our search for truth it is important that such records be made, but we must not draw hasty conclusions. There is a general tendency among patients to attribute any unusual developments or any intercurrent disease or symptoms to *x*-ray treatment, when, if one analyzes the symptoms, they are very generally a part of the disease for which the patient is being treated, or are due to an intercurrent affection such as would occur to any one suffering from any particular disease and treated by any particular method. Even family physicians are apt to attribute any complications that arise during the course of *x*-ray treatment to the treatment itself rather than search for the cause as one would search for the cause of a disease at any other time. This tendency does harm in two ways: *First*, it prejudices the patient and physician against *x*-ray treatment when often it is the only treatment which offers them hope of relief. *Second*, it blinds the attending physician to the real cause, and leads him to carelessly neglect the necessary search for the true cause, thus often allowing the patient to suffer unnecessarily. All roentgenologists who have had much experience in the treatment of malignant disease, especially about the chest, must have heard their patients complain of rheumatism about the shoulders and about the chest, and often must have had the attending physician explain that it was due to the *x*-rays, when, as a matter of fact, if one investigates carefully, the cause of these pains is due to metastasis developing in the bones or in the spinal column, or to an extension of the disease elsewhere in the chest. The treatment is, therefore, often interrupted, as I have experienced repeatedly, when, as a matter of fact, the only thing that would give comfort and prolongation of life is an increase in the amount of treatment rather than a diminution. As roentgenologists, therefore, we must be most cautious in attributing intercurrent affections to *x*-ray treatment, unless it is proven more definitely than in any of the cases on record.

In the first case, reported by Dr. Bryan, the left chest was treated three times in front, and twice through the back within

two months' time without producing any dermatitis. At the end of two months a slight amount of effusion was found at the left base, and he believes that this was due to the treatment, when, as a matter of fact, fluid in the chest is quite common in connection with mediastinal tumors, even with any kind of treatment. Therefore, I see no reason for concluding that this is due to the *x*-ray treatment at all.

The second patient had large tumor masses in the neck and the mediastinum; she was given a series of *x*-ray treatments February 1914, and on September 20, 1915, she reëntered the hospital with fluid in the chest. This the author concludes is due to *x*-ray treatment, because she had received some treatment previous to entering the hospital. Based upon the facts presented, the diagnosis of pleuritis is surely unjustified, and must be regarded merely as a coincidence.

Strasser's patient was 68 years old, had had gout over fifteen years; for nine years glycosuria, fatty and arterial sclerosis, and for four years bronchial catarrh; Before coming under treatment he had twice a small area of bronchopneumonia in the left lobe, and an attack of angina pectoris. He was treated in all four times: June 10 the right thorax anteriorly, June 14 the right supraclavicular region, June 17 the right axilla, and June 28 the right chest posteriorly. Later the patient developed more evidence of angina pectoris and finally developed signs of a rightsided pleural effusion. Surely since, in the case of a patient suffering from the affections already enumerated before *x*-ray treatment was given, it would not be unusual that he develop a pleural effusion, it is not necessary to assume that it is due to the very small amount of treatment given.

The case referred to by Quadrone, was a twelve year old girl who suffered from a general lymphomatosis. She was treated by the *x*-rays and developed a pleuritic effusion from which she ultimately died. An autopsy was refused, but the exudate removed before death had the characteristics of tuberculosis. One can see clearly, therefore, that this condition should not be credited to the *x*-rays.

With regard to the report of Primbraam and Rotky, these authors express in their article the belief that the acute nephritis was toxic in origin rather than due to the *x*-rays, and they merely mention the *x*-rays as a possible cause, but believe that the toxic nephritis was due to the rapid absorption of the degenerating material. At the same time that the acute nephritis developed there had also developed abscesses in both mammary glands, and yet the treatment had been confined to the spleen. One can see, therefore, that such an assumption of the nephritis being due to the direct action of the rays on the kidneys is entirely unjustified.

I have treated at least a thousand cases of disease about the chest. It is well known that I give massive doses, and yet not one patient has had a pleural effusion develop that was not due to an extension and progression of the disease or due to an acute intercurrent infection, which had all the characteristics of an acute infection. In individual cases I have given a hundred times as much treatment as was given to any of these patients mentioned, over the chest, without the production of any pleurisy, and I have treated abdominal patients with a hundred times as much treatment as was given in the abdominal cases reported by Primbraam and Rotky, in which I obtained the disappearance of tumor masses with increase in the patient's weight and general improvement in the patient's condition, with no evidence of an acute nephritis. I, therefore, believe that the diagnosis of *roentgen* pleuritis and *roentgen* nephritis, and other affections that develop during the course of treatment, must be made with the greatest caution and should be proven before announced. GEORGE E. PFAHLER

X-RAY EXPERIENCES AT THE FRONT

In this issue we give space to a translation from advance sheets of a publication by

our French colleagues (Drs. Desplats and Wickham). We are sure our readers will appreciate this first-hand recital of experiences in the zone of the advance.

There is no new principle in any of the methods described, but this does not lessen the value of the article, for it presents a viewpoint; and we are anxious to get the viewpoint of a number of different men with a large experience in war work.

A careful research of the literature has convinced the editors that there is very little likelihood of any method described at this late date being a new one. The ring localizer was in use at least as far back as 1901, and probably earlier. Testing the mobility of superficially located projectiles was described in some of the earliest papers on roentgen ray work. The principle of marking the skin vertically over the foreign body and then calculating, or measuring, the depth by the shift of the shadows of the foreign body and of the marker was described early in 1896 by Morize in France, and simultaneously by physicians in England and Germany. The use of a chart for reading off the depths was described at least as far back as 1902 by Little; and shortly after the outbreak of the present war by nearly a dozen workers in the hospitals of the Allies.

Americans are especially interested in the remarks of Doctor Desplats on the need of provision for extraction of foreign bodies under the fluorescent screen, employing either the open screen or the bonnet method. Too many American surgeons are as yet unfamiliar with the technique necessary; yet, as our colleague states, this technique is not at all difficult to master. It is important, however, to have the coöperation of surgeon and roentgenologist in working out the details of an operating plan which at the same time meets the demands of a "surgical conscience" and its roentgenological counterpart, an "*x*-ray conscience." Just as the surgeon by long attention to operating room technique comes to a point where he mechanically observes the rules of asepsis, so also a certain autonomy of behavior may be developed in connection with *x*-ray work with the result that the roentgenologist automatically keeps himself protected from the dangers attending his profession. Our French colleagues tell us the method of operating with screen aid is becoming more and more recognized. Surely the United States Army Medical Department will not fail to profit by the recent experiences of our Allies, and will be duly influenced by the trend of opinion, as expressed in the article of Doctor Desplats.

J. T. C.

The Nineteenth Annual Meeting of the American Roentgen Ray Society will be held at Fort Oglethorpe, Ga., and Chattanooga, Tenn., Wednesday, Thursday and Friday, September 4th, 5th and 6th. Final arrangements have not been completed, but it is probable that the day sessions, at least, will be held in Camp Greenleaf, the greatest medical military training camp in the world. We are assured of adequate hotel accommodations and it is not improbable that accommodations may be secured at Camp Greenleaf for those who prefer that added touch of camp life. In addition to the especial present interest, this region is rich in historical interest and natural beauty, and will afford a splendid climax to the vacation period or a satisfying substitute for the many who will find it impossible to take their customary vacations this summer. Already there are offered papers sufficient to insure a program of more than average value. Complete details will be given in the next issue of the JOURNAL. In the meantime, inquiries and communications may be addressed as follows: Concerning the scientific program, address the President, Major Willis F. Manges, M.R.C., Camp Greenleaf, Fort Oglethorpe, Ga.; concerning general arrangements, address the Chairman of the Executive Committee, Dr. David R. Bowen, 235 S. 15th Street, Philadelphia; concerning the exhibits, address Mr. Paul B. Hoeber, 69 East 59th Street, New York.

TRANSLATIONS & ABSTRACTS

ALVAREZ, W. C. AND TAYLOR, F. B. Changes in Rhythmicity, Irritability, and Tone in Purged Intestine. (*J. Pharmacol. & Exper. Therap.*, Balt., November 10, No. 5. Ref. *J. Am. M. Ass.*, Dec. 15, 1917, p. 2070.)

The well-purged rabbit is likely to be apathetic and to look sick. Its bowel is full of gas and fluid, and the mesenteric circulation is disturbed. Excised segments beat poorly and irregularly in Locke's solution; they fatigue quickly; and respond poorly to drugs. Some parts of the bowel are abnormally irritable while others fail to respond at all to powerful stimuli. This unevenness in the gradient of muscular forces must interfere with the steady progress of food through the intestine, and probably favors the production of colic and gas pains. The conclusion drawn by Alvarez and Taylor is that it is not wise to purge shortly before an operation in which the bowel must stand the insults of drying, handling, cutting and sewing.

WEIL, E. ALBERT, Roentgenotherapy of Tuberculous Peritonitis. (*Paris méd.*, October 13, VII, No. 41, p. 289. Ref. *J. Am. M. Ass.*, Dec. 8, 1917.)

Weil remarks that of all the various methods of treating tuberculous peritonitis that have been applied to date, systematic utilization of sunlight and sea air seem to have the most testimony in their favor. But both require the suitable environment which is within the reach of comparatively few. On the other hand, with the roentgen rays we can apply the chemical rays anywhere, even to outpatients. He has been applying roentgenotherapy systematically since 1914, using large doses of very penetrating rays, filtered. Some of the children he treated had the fibrous form of peritonitis and some the form with ascites. In every case in which there was not already generalization of the disease in the lungs or pronounced cachexia a complete cure was rapidly realized, with complete restoration of the general health. He used a Coolidge tube, a 5 mm. aluminum filter, a 20 cm. spark and a 1.5 or 2 milliampere current. The exposures were repeated about monthly, but he reduced the strength a little each time to ward off skin trouble. This technique does not entail radiodermatitis nor generalization of the tuberculosis. After the first series there may be a recrudescence of the fever and persisting malaise, but this reaction was never serious in his experience, and he never allowed it to interfere with his giving the effectual dose of 12 or 14 H units in the course of four successive days on the four quarters of the abdomen. In case of too much debility the series can be fractioned to spread out over ten or twelve days.

MEDICOLEGAL. Barring of Action for Roentgen Ray Burn. (Ogg vs. Robb, Ia., 162 N. R. W. 217. *J. Am. M. Ass.*, Sept. 29, 1917, p. 1108.)

The Supreme Court of Iowa affirms a judgment in favor of the defendant in that the plaintiff's alleged cause of action was barred by the statute of limitations. The court says it was alleged that in 1901 the plaintiff, then under 17 years of age, broke his right wrist. In July of that year, the defendant called the plaintiff in his office, without the knowledge or consent of the plaintiff's parents, and experimented on him with a roentgen ray machine to secure pictures of his hand and wrist. That the defendant continued for ten days in said experiments and used the roentgen ray machine on the plaintiff's hands and wrist and made long and close exposures. That as a result the skin on the hand and wrist became discolored. That the defendant then informed the plaintiff and his parents that the use of the roentgen ray machine caused such discoloration, and then falsely and fraudulently informed them that this discoloration was of no particular consequence and would be temporary in its effects, fraudulently concealing from them the true effect of radio-exposure produced by the roentgen ray machine. That the defendant then treated the discoloration for a time and it apparently disappeared, leaving a scar, but with the usual use of the hand. That the plaintiff and his parents fully relied on the statement and advice of the defendant as to the temporary effect of the roentgen rays, and nothing further

was done in regard thereto until 1912. That the use of said machine by the defendant produced a cancerous condition which was latent until 1912, and the plaintiff had no knowledge of said condition until then. That then the tissues of the right hand where the roentgen rays had been applied broke down and became an epithelioma or malignant cancerous growth, which caused great pain and necessitated the amputation of the right forearm. Was the plaintiff's cause of action concealed by the statement of the defendant that the original burning was but temporary and was of no particular consequence, and that the defendant fraudulently concealed the true effect produced by the use of the roentgen ray machine? The plaintiff alleged that he was burned in 1901 and, as he alleged, by the negligence of the defendant. The fact was known to the plaintiff and his parents. All damages which subsequently developed were traceable to and based on that act. By the original act the plaintiff was injured, and, as the petition alleged, by the negligence of the defendant. He would have been entitled to some damages at that time; and, if it be true that cancer necessarily and in all cases is the result of such burning, or if cancer is the probable result, such fact could be shown as bearing on the question of damages in an action for the original injury. If cancer is not the necessary or probable result of such burning, then the defendant's statement would be more or less of an opinion, and, in that case, the fact that later and in 1912 a cancerous condition did develop and the plaintiff's damages might thereby be increased, would not constitute a new cause of action. It would seem then that the plaintiff's cause of action accrued at the time of the original injury.

McMahon, F. B. and Carman, R. D. The Roentgenologic Diagnosis of Primary Carcinoma of the Lung. (*Am. J. Med. Sc.*, January, 1918, Vol. CLV, No. 550, p. 34.)

Primary carcinoma of the lung is believed to be rare, only 428 cases having been reported. Most of these are from postmortem data, so that the roentgen rays in the future may show the disease to be less rare than hitherto supposed. The decisive value of the roentgenological examination has not been generally recognized, perhaps because the study has been almost wholly confined to isolated cases.

"In most instances the roentgen findings in primary carcinoma of the lungs are pathognomonic of the disease, and may be the first to suggest the exact nature of the pulmonary lesion. The areas of increased density, their size, shape, and position, are usually characteristic and aid in the clinical diagnosis more than most other signs. This does not imply that all other signs can be slighted or discarded, for it is by a careful collection and correlation of all the facts that a satisfactory differential diagnosis may best be established.

"In the roentgen examination three types of the disease are recognizable; namely, the infiltrative, the military, and the mixed, which correspond to the gross pathological groupings. For convenience each type will be discussed separately though many characteristics are common to all. A striking feature in all types and one of considerable diagnostic importance is the absence of practically any increase in mediastinal density. The presence of extensive pleural involvement in primary carcinoma of the lung renders the interpretation of the roentgenogram correspondingly more difficult, but not impossible. The presence of large pleural effusions tends to completely mask the roentgenographic picture and to conceal the underlying and principal pathological condition in the lung. A second roentgen examination is necessary after thoracentesis. Fortunately these latter two conditions rarely occur until the terminal stages of the disease.

"In the stereoscopic study of the infiltrative type of primary carcinoma of the lung, the roentgenogram shows one or more areas of increased density along the roots of the larger bronchi. The shadows are homogeneous or partially mottled. The borders are infiltrative and not sharply demarked. The areas of density are wedge-shaped, with the apex pointing toward the hilus, and there may be either unilateral or bilateral involvement. The degree of density is marked but varies with the extent and duration of the disease. Until there is extensive involvement the process does not reach the periphery of the lung, so that small areas of air-filled lung tissue may be seen between the growth and the chest wall. The most frequent site of this type of lesion is in one of the lower lobes. There is always present a hazy shadow-zone surrounding the growth, due to congestion from active hyperemia or passive congestion due to mild pressure, or to

both conditions. The roentgen shadows found in this type of carcinoma of the lung at times make the diagnosis difficult. The roentgenogram will show the presence of a lesion in the lung, but if the neoplasm is in an early stage the areas of density may not be entirely typical of primary infiltrative malignancy. In such cases the roentgen diagnosis can be only tentative, and if the other findings are not sufficiently corroborative a subsequent roentgen examination should be made.

"Two of the cases studied by us were of the infiltrative type. In one (Case 176118) the roentgenogram showed the presence of a lesion in the lower right lung, the exact nature of which was doubtful until an exploratory thoracotomy and a microscopic examination were made. In the other case the lesion was more extensive and typical of primary malignancy. Postmortem examination confirmed the diagnosis.

"In the miliary type there are innumerable regular, irregular, or conglomerate small areas of increased density extending throughout all the lobes. Their borders are poorly defined and not sharply circumscribed from the surrounding parenchyma of the lung because of the marked infiltrating character of the neoplasm. The process is diffuse throughout both lungs and the areas of density are distributed as uniformly near the hilus as in the periphery of the lung. The shadows show no tendency to be arranged in groups or clusters. There are usually no true cavities but there may be localized dilatations of the smaller bronchi and bronchioles, the walls of which may be differentiated from the cavity formation only by the stereoscope. Dilated bronchioles are recognized roentgenologically by the absence of any thickened wall.

"The mixed type of primary carcinoma of the lung includes a combination of the infiltrative and the miliary forms. In this type are found poorly circumscribed, homogeneous, or slightly mottled areas of increased density in one or more parts of the lung, and multiple smaller areas of increased density similar to those found in the miliary type, diffusely studding the entire remaining portions of both lungs. Two of the cases (Cases 160751 and 109685) were of this type. In both the diagnosis was confirmed by a postmortem examination."

The authors thus demonstrate the close dependence of the roentgenographic signs upon the pathology of pulmonary carcinoma. The following shows that the roentgenologist must not only be a pathologist but must likewise be a student of clinical diagnosis.

"The differential diagnosis of primary carcinoma of the lung must be made from a large number of other pathological conditions found in the thorax, which in the roentgenogram may in a measure simulate carcinoma. A long and detailed description of each is unnecessary here, but the salient and important points concerning the more confusing conditions are as follows:

"Bronchiectasis may be confused with the infiltrative type of primary pulmonary carcinoma in the early stages, or when either lesion is atypical. Moore has shown, however, that in bronchiectasis the shadow is fan-shaped and extends to the periphery; also that when a lower lobe is involved the costophrenic angle is obliterated and the process is usually though not always bilateral. Further, in bronchiectasis, cavitation is invariably present, with shadows suggesting dense fibrosis around the cavity. When bronchiectasis is suspected the patient should be induced to attempt the evacuation of the contents of the cavity by forced coughing and expectoration, in order that the cavitation may be shown more clearly in the second roentgenogram.

"Pulmonary abscess and encysted empyema are usually not difficult to differentiate from carcinoma. In such cases the areas of increased density are sharply circumscribed and surrounded by a shadow zone of inflammatory change beyond which is the normal healthy lung area. The presence of the shadows of a fluid level with a gas bubble above in an abscess cavity may be further aids. Finally, the shadow of a thickened pleura is more frequently associated with these conditions than with pulmonary malignancy.

"In lobar pneumonia the shadows are usually localized, soft and hazy, and vary in density with the stage of the disease. In the early stage there may be only a slight difference in density from the surrounding lung tissue, while in the later stages the density is greater and the shadow is sometimes mottled. Any part of the lung may be involved but the condition usually includes practically an entire lobe. The pleura is much more frequently in-

volved. Clinically, of course, the differentiation is even more emphatic.

"Regarding syphilis of the lung very little is known definitely from the clinical standpoint and less from the roentgen standpoint. While the disease seems to be more common than formerly and is recognized clinically, Dr. W. W. Bissell informs us that he has never seen a case in 4000 postmortems. In one proved case in the clinic the roentgen examination revealed marked enlargement of the mediastinal shadow with areas of increased density in the regions of the main bronchi while the periphery was free. The heart shadow was greatly enlarged and the aorta dilated. At autopsy multiple diffuse areas of dense patchy fibrous infiltration were found in both lungs near the hilus, together with a large heart showing marked myocardial changes and a saccular aneurysm of the ascending aorta. We have never seen or at least have never diagnosed gumma in the parenchyma of the lung. Gumma in the mediastinum may be differentiated from primary carcinoma of the lung. The shadow is usually large, well circumscribed, homogeneous, and unilateral or bulging to one side.

"In primary sarcoma and lymphosarcoma of the lung the roentgenogram corresponds in its characteristics to that of mediastinal gumma, except that in sarcoma the tumor shadow tends to be larger. Infiltration and involvement of distant portions of the lung rarely occur.

"In Hodgkin's disease the roentgenogram usually shows areas of increased density which are symmetrical, bilateral, well circumscribed and limited to the mediastinum. There are no changes in the density along the course of the main bronchi unless the tumors are very massive or there is marked myocardial degeneration leading to much passive congestion.

"In actinomycosis and allied affections of the lung the roentgen findings may be differentiated from those of primary malignancy. The areas of increased density are 'stringy' and fan-shaped in arrangement, usually found in the periphery and surrounded by a soft shadow zone of inflammatory reaction. The pleura is involved early and there may be an area of increased density corresponding to a tumor on the bony chest wall.

"There is a marked difference in the roentgen shadows found in primary and metastatic malignant disease of the lungs. As in the metastatic carcinomas, sarcomas, and mixed tumors the roentgenogram shows the same characteristics and their roentgen appearances may be enumerated collectively. According to Moore and one of us (Carman) the areas of density in metastatic malignancy of the lung are rounded, regular, clearly circumscribed, homogeneous, without inflammatory reaction; they vary in size, are usually multiple, and may occur in any part of the lungs.

"Cysts of the lung show in the roentgenogram as large, clearly circumscribed and homogeneous areas of increased density. They are usually single and are found in the right lower lobe.

"Fibromyxoma of the lung is easily differentiated from primary carcinoma. In the former the area of increased density is large, massive, homogeneous, and well circumscribed. An entire lobe is usually involved, most commonly the upper. Since the tumor is slow-growing there is very little, if any, congestion-shadow surrounding it."

This is clear and definite, but the paragraph on the differentiation from tuberculosis is far less satisfactory. They say:

"The differentiation from the roentgenogram of pulmonary tuberculosis will seldom be difficult. In chronic pulmonary tuberculosis the periphery is the common location of the areas of increase density, with very few, if any, changes in the hilus. The shadows are more circumscribed. The upper lobes, especially the apices, are usually the first and most commonly involved. Cavitation may be present, and there is frequently an associated pleuritis. In acute or subacute miliary tuberculosis the individual areas of increased density are smaller, more regular in shape, more discrete, more uniform in size, and with greater peripheral involvement than in the miliary type of carcinoma."

The symptomatology indicates in a striking manner the close resemblance clinically which pulmonary carcinoma bears to phthisis. Chronic cough, sputum, hemoptysis, hoarseness, loss of weight, fever and pleuritic effusion, all considered distinctive signs of tuberculosis are yet present in carcinoma. The authors in the forepart of the article state that:

"Cough is an early symptom; it is usually slight but constant and distressing. Expectoration, if any, is moderate in amount; it consists chiefly of mucus and at times may be blood-

stained. Hemoptysis is common, but the quantity of blood is small. Inspiratory dyspnea comes on early, is nearly always present and is exaggerated by exertion. Hoarseness and change of voice from pressure-paresis of one or both vocal cords is common. Pain is a prominent, but not early, symptom. It is associated with substernal pressure symptoms or pleural involvement. Pressure may give rise to dysphagia. Weight loss and weakness are pronounced and progressive. A rise of temperature of 0.5° to 1° is usual; chills and sweats are rare. The infiltrative type runs a longer course than the miliary or mixed type.

"The physical findings are such as would be expected in massive or patchy infiltration and consolidation of the lung from any cause. Pleural effusion may mask these signs; on aspiration the fluid may be straw-colored, blood-stained, or darkly discolored. Engorgement of the veins of the anterior chest wall and edema of one or both arms may be present. Enlarged supraclavicular or axillary glands, are suggestive, and removal of such glands may aid the diagnosis."

This article emphasizes unconsciously the deeply important fact that roentgen ray interpretation demands a wide knowledge of pathology and clinical medicine. The roentgen ray plate may supply the data but we see only what we learn to see.

Such an article as this one by McMahon and Carman extends the confines of roentgenological knowledge.

HARBITZ, FRANCIS. Extensive Calcification of the Lungs as a Distinct Disease. (*Arch. Int. Med.*, Jan., 1918, p. 139.)

Calcium deposits may take place in degenerated or necrotic tissue, in exudates and blood clots, in lymph nodes, in lungs, in the arteries and in certain cases in many other organs of the body. Calcification may occur on a large scale and give rise to distinct disease. Virchow showed that in bone tumors, osteomalacia and leukemia, a "calcium metastasis" may take place, especially in the lungs, the left ventricle, the pulmonary veins, the gastro-intestinal walls and the kidneys. A selective deposit of carbonates and phosphates of calcium also takes place in bursæ and tendon sheaths, as for example in the subacromial bursa. In "calcinosis universalis" a calcium infiltration is found in nearly all tissues excepting those of internal organs and joints, while the bones appear normal. An extensive and most extraordinary calcification may occur in the lungs. The author's description of the autopsy in his own case is striking and instructive.

"There was no fluid in the pleural cavities; a few fibrous bands were present over the left lung and general adhesions over the right; the lungs were large, as in croupous pneumonia, solid and heavy, feeling like stones and sinking in water; the right lung weighed 2,750 gm., the left 2,130, in all 4,880 gm. Placed on the base, the lungs stood by themselves; in consistency the substance was almost like wood, but not uniformly so, being apparently full of small, solid particles, and under the pleura here and there were small, white, flat masses of mineral nature. The substance could be cut only with difficulty and felt like porous bone. Passing the finger over the surface felt like rubbing it over sandpaper, and here and there were round or irregular concretions. The distribution of mineral matter was about the same in both lungs, perhaps a little more marked in the left. The cut surface was peculiar, reddish-brown, with numerous small holes in an extensive stroma; bloody, frothy fluid exuded. The first impression that the lungs were free of air and compact was not correct; air was present everywhere, but the air-containing tissue was less in amount than the interstitial tissue with the mineral deposits. Areas in the anterior border of the right lung and the anterior surface of the upper lobe contained more air than other parts of the lungs. After drying a small slice of lung substance it had a peculiar yellow red color and a porous surface which felt like sandpaper and from which small calcareous granules would fall out. In both apices, at the hilus of the lungs and in the lymph nodes in the neck, were small, old caseous foci. The pulmonary arteries were sclerotic but not calcified or dilated; the pulmonary veins were normal. No calcification was present in the larger bronchi, trachea, or larynx.

"The extensive lime deposits in the lung in this case, so extensive that it seems quite remarkable that life lasted as long as it did, do not appear to be duplicated by any reports in the literature either of genuine 'metastatic' deposits or of the few cases in which there was no definite cause. It is noteworthy that the

lungs weighed nearly six times as much as normal and that on first impression they appeared to be almost entirely airless; the deposits were diffuse and evenly distributed throughout the lungs, showing that they were independent of local changes such as thrombi or infarcts."

A similar case reported by Tschistowisch was associated with multiple myeloma. A case described by Pari was associated with cancer of the uterus with bone metastasis. Another case reported by Wells occurred in the course of myelogenous leukemia. Many other cases of partial calcification have been reported by various clinicians in association with a very large variety of diseases, so that it is impossible to regard the condition as consistently secondary to any definite or recognized group of diseases. But fundamentally there is in all cases a profound disturbance in calcium metabolism dependent upon disordered function of glands of internal secretion.

ABBE, ROBERT. Paget's Disease of the Bone: Excellent Repair after Surgical Operations. (*Jour. Am. M. Assn.*, Vol. 70, No. 6, Feb. 9, 1918, p. 371.)

Sir James Paget many years ago described the disease which has since borne his name. Much later the Germans renamed the disease "osteomyelitis fibrosa." To many roentgenologists the identity of osteomyelitis fibrosa (or osteitis fibrosa) with Paget's disease of the bone is a matter of surprise. Abbe objects to the German name as clinically delusive, because there is nowhere a fibrous change but only a large bony overgrowth.

He says: "Though the disease appears first in some isolated bone, it is not essentially a 'one-bone disease.' Usually it is noticed in a curvature and enlargement of one tibia, femur, clavicle or ulna; and the surgeon often examines the skeleton in vain endeavor to find a second diseased bone. Nevertheless, in almost all cases, a roentgenogram of the head will reveal a thickening of the frontal, parietal and occipital bones, sometimes of enormous degree —to an inch in thickness, with no prior suspicion.

"In the skull the enlargement is never at the expense of the cranial cavity. In the long bones there is curvature with much increase in bulk, by periosteal and endothelial growth. Occasionally, though rarely, a sarcomatous degeneration may ensue. While the disease is not widely recognized, it is by no means so uncommon as would be implied by the general ignorance of the profession about it, and quite a number of cases go unrecognized.

"In fourteen private cases of this disease seen during recent years, four cases with jaw complication have come to my notice. In two of these, extensive surgical operation was required and most excellent results were obtained. Its slow development is emphasized in one case of a woman whose lower jaw I had treated for a cyst on several occasions for twenty-two years. Only three years ago it suggested itself to me that it might be Paget's disease, and, on taking a roentgenogram, I found a very thick, typical skull. When its nature was thus shown, I ventured a wide removal of the outer plate and all cancellous and cystic structure of the forward half of one side of the lower jaw, leaving the inner compact structure."

The roentgenologist must be on his guard therefore in cases of hyperplasia of the jaw, and should roentgenograph the head to clinch the diagnosis of Paget's disease of one of the longbones.

WALKER, C. B. The Diagnosis of Pituitary Disorders. (*Interstate M. J.*, 1917, XXIV, 817.) (Ref. *Internat. Abstr. of Surg.*, Jan., 1918, p. 24. Robitshek.)

Although *x*-ray demonstrations of the enlarged sella turcica are a very reliable diagnostic point in determining the presence of strumous, tumorous or hyperplastic condition of the hypophysis, it should be noticed that many cases of dyspituitarism, especially in the last two groups discussed, may show no enlargement of the sella and yet may have a supracellar or interpeduncular or even a more distinct tumor giving glandular or ocular field manifestations without distorting the sella.

BOOK REVIEWS

DISEASES OF THE CHEST AND THE PRINCIPLES OF PHYSICAL DIAGNOSIS. By George William Norris, A.B., M.D., Assistant Professor of Medicine in the University of Pennsylvania; and Henry R. M. Landis, A.B., M.D., Assistant Professor of Medicine in the University of Pennsylvania. With a Chapter on the Electrocardiograph in Heart Disease by Edward B. Krumbhaar, Ph.D., M.D., Assistant Professor of Research Medicine in the University of Pennsylvania. Pp. 782. Price, cloth, $7.00 net. W. B. Saunders Company, Philadelphia and London, 1917.

A careful study of this treasure-house will add immeasurably to the diagnostic ability of every man who professes to interpret the roentgen findings of the chest. As a work for frequent study and reference this book should find a place in the library of every roentgenologist.

In the roentgen ray features of this treatise the authors have had the assistance of two of our well-known colleagues, Doctors Pancoast and D. R. Bowen, of Philadelphia, whose careful work is abundantly attested by the pages of this book. In a very admirable manner the roentgen findings are incorporated into the text in such a way that the result is a complete presentation of the physical diagnosis of the heart and lungs in health and disease. The roentgen ray findings are seen in their proper relation to the clinical aspects of the case.

Nevertheless, in spite of the very favorable impression created by the general appearance of the volume, we read the authors' opinion that the roentgen ray enables us to "control" percussion findings and often definitely establishes the presence or absence of deep-seated mediastinal lesions in cases in which ordinary physical diagnosis only permits us to "suspect" the lesion. On the other hand, "the ordinary methods of diagnosis are far superior to the roentgen ray in cases of incipient or early pulmonary tuberculosis. . . . In these instances the mistakes are usually on the side of the roentgenologist. The roentgen ray is rarely of much use as an early diagnostic method in cardiac or pulmonary disease." We feel that in these statements the distinguished authors of this work have taken too reserved a stand, and believe that the future will demonstrate a much larger field of usefulness for the roentgen rays in diseases of the chest than the above statements would seem to indicate.

J. T. C.

A MANUAL OF *X*-RAY TECHNIC. By Arthur C. Christie, M.D., Major, Medical Reserve Corps, U. S. Army; Chief, Section of Roentgenology, Surgeon General's Office, U. S. Army; formerly Captain, Medical Corps, U. S. Army, and Professor of Roentgenology and Operative Surgery, Army Medical School, Washington, D. C. With 48 illustrations. Second edition, revised and enlarged. Philadelphia and London, J. B. Lippincott Company. Price, cloth, $3.00.

This manual was prepared with a view to the needs of the medical service of the United States Army. The small number of medical officers in the service of the regular army necessitates frequent change of station, so that it often becomes necessary for one to familiarize himself in a comparatively short time with the essentials of roentgenologic technic. The author recognizes the need of specializing in roentgenology and urges that whenever possible the services of a specialist be secured. The manual before us is intended to instruct the men who are so situated that they cannot avail themselves of the help of the specialist, and should thus be of value to a large class of civilian physicians.

Careful perusal of the latter part of the work impresses one that the author has exercised sound judgment and commendable reserve, especially in the discussion of moot points, and has given his readers a fair statement of the legitimate field of roentgen diagnostics and therapy. In the chapter on therapy the author acknowledges the assistance of his colleague, Dr. Thomas A. Groover.

The technical descriptions are necessarily brief, considering the size of the work (150 pages). In fact, our one criticism would be on this point.

J. T. C.